PALISADES SUBBASIN ASSESSMENT AND TOTAL MAXIMUM DAILY LOAD ALLOCATIONS

Antelope Creek Dam 10/2/2000 D. Sharp

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WATERSHED DESCRIPTIONS

The Palisades subbasin covers approximately 537,407.6 acres or 839.7 square miles in Idaho. This area provides approximately 16.5 inches of runoff per year for the drainage, which equals roughly 5,054,578 acre feet per year (Merigliano 1996). The USGS has divided the subbasin into 11 sub-watersheds (**Figure 8**) at the fifth field HUC level. The subbasin is roughly divided by Palisades Reservoir and the South Fork Snake River that runs in a northwesterly direction. Pine Creek sub-watershed is located entirely in the northern part of Palisades subbasin, while McCoy Creek, Bear Creek, and Fall Creek sub-watersheds are located entirely in the southern portion. Therefore, these sub-watersheds are true watersheds. Antelope Creek, Dry Canyon, Swan Valley, Rainey Creek, Palisades Creek, Big Elk Creek and Indian Creek sub-watersheds have a portion of their drainage both north and south of the reservoir and river. Therefore, these sub-watersheds are composite watersheds. The dam that forms Palisades Reservoir also produces hydroelectric power. After a recent upgrade, it operates four generators, each with a capacity of 44.1 megawatts for a total of 176.6 megawatts. About 2 million acre-feet of water are used annually for power. Palisades Dam has a fish screen that has been constructed on Palisades Creek, which joins the South Fork approximately 3 miles downstream from the dam. The YMCA camp located on Big Elk Creek has operated a hydroelectric facility since 1987. With a capacity of 7.4 kilowatts, the power is utilized only for the camp. Fish passage is insured via a minimum 25 percent streamflow (Idaho Water Resource Board 1996). The following are descriptions of the eleven sub-watersheds. Unless otherwise stated, the description of each sub-watershed was compiled from 1996 BURP data (IDEQ 1996), the 1980 TNF stream inventory, the 1999 cutthroat distribution survey reports (TNF 1999a) and the 2000 cutthroat distribution survey reports (TNF 2000). All stream type classifications are based on the system proposed by Dave Rosgen (1996). The sub-watershed area (Idaho Department of Water Resource 1994-1997) and stream mileage (Idaho Department of Water Resources 1994-1996) are provided by Geographic Information System (GIS) calculations.

Antelope Creek sub-watershed 1704010401

Draining 73635.8 acres (115.1 miles^2), the Antelope Creek sub-watershed accounts for 13.3 percent of the subbasin. It is a composite watershed, with Burns Creek drainage east of the South Fork Snake River, and Antelope Creek west of the river. Other streams in the sub-watershed include Black Canyon Creek, Little Pine Creek, Mud Creek, Nelson Creek, Table Rock Creek and Wolverine Creek. All of the streams comprise a total of 184 stream miles. The East Side Soil and Water Conservation District published a report in 1989 regarding the extensive sedimentation problem in the Antelope Creek sub-watershed. Concerns over agricultural impacts to water quality were the impetus for the study. Stream surveys carried out on private land along Pine, Rainey, and Antelope Creeks indicated that trout-rearing habitat, trout spawning potential, and stream bottom invertebrate habitat were degraded by high levels of cobble embeddedness from fine sediments with a substrate dominated by fine-grained (<0.25”) sediment (Blew 2000), and by altered and unstable streambank features.

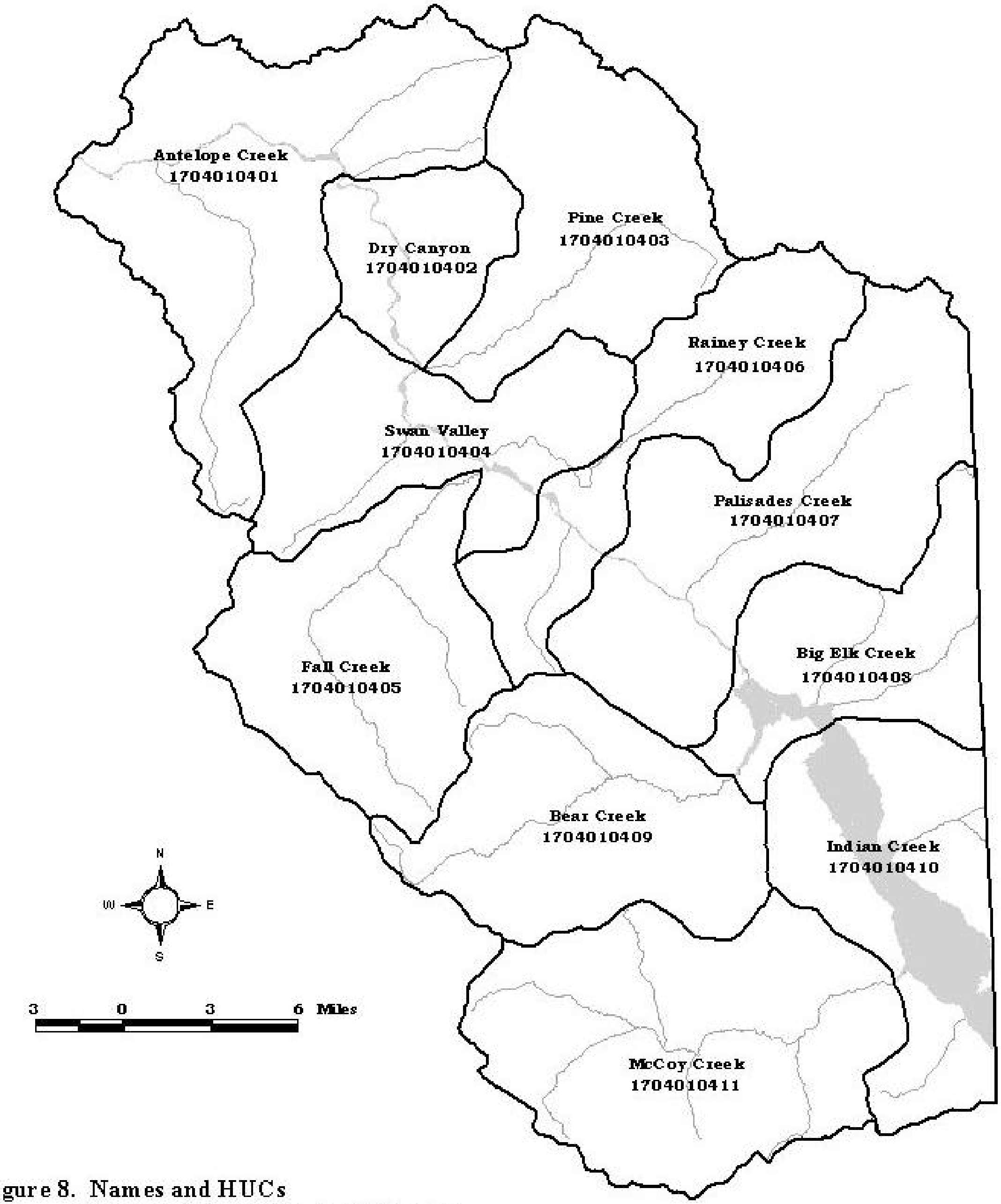

Figure 8. Names and HUCs of watersheds within the Palisades subbasin.

Antelope Creek is a second order Rosgen stream type B. Although it naturally flowed to the South Fork, a dam on private property retains all of the water from Antelope Creek for irrigation. All age classes of cutthroat trout are present in healthy populations and may have traveled from the South Fork before the dam blocked Antelope Creek. Predominant riparian vegetation includes red-osier dogwood and willows, with lodgepole pine and Douglas-fir in the overstory. Grazing activity is depleting vegetation along some areas of the stream and appears to be causing some bank sloughing that increases sediment levels in the streambed (TNF 2000). Nelson Creek is a Rosgen B channel, first order stream tributary to Antelope Creek. Willows are very dense, providing up to 80 percent canopy cover for the stream. The substrate of Nelson Creek is gravels and silt. Fine sediment levels seem elevated due to some over-grazing and road washouts where the road has encroached on the stream, disallowing the natural stream meanders (TNF 2000). Table Rock Creek is a small, second order stream with a Rosgen B channel type. Although Table Rock Creek would normally flow into the South Fork Snake River, the last mile is dry due to complete utilization for irrigation. Cattle and human impact is high, creating weak and sloughing banks. A road parallels the stream for most of its length.

Bear Creek sub-watershed 1704010409

With Bear Creek as the primary waterway, the Bear Creek sub-watershed encompasses 50469.9 acres (78.9 miles^2) which is 9.1 percent of the subbasin. This fifth field HUC is a true watershed. It contains 124.9 total stream miles including Elk Creek, Muddy Creek, Dead Man Creek, South Fork Bear Creek, North Fork Bear Creek, Camp Creek, Spring Creek, and Snail Creek. Bear Creek is a Rosgen B type stream with a two percent gradient and a V-shaped valley with high sinuosity. The upper reaches are a large beaver complex entirely. A great deal of channel cutting has occurred due to high flows. In addition, many sharp meanders have deeply undercut the banks causing slumping and mass wasting. Both historical and current grazing impacts can be observed. The north and south forks also show a great deal of channel and head cutting from high flows. The lower reach of Bear Creek is larger, becoming a Rosgen C type stream. Historical grazing impacts are apparent, and a heavily used recreational pack trail fords the stream several times. The riparian vegetation of the entire stream varies from thick willow growth, to patches of willow and dogwoods. It some places, the forested overstory gives way to sparse sagebrush and forb communities bordering the riparian area.

Elk Creek is also located in this drainage. It is a Rosgen type A-B with a predominately V-shaped valley. It flows with a gradient of three percent to 11 percent and has moderate sinuosity. The upper reaches are stable with bedrock channels and a high rock content in the banks. Many springs feed the creek providing a stable base flow. At roughly mid-reach there is riparian degradation on both banks. Several sediment fans occur where beaver dams have failed. Channel braiding has also occurred in several areas. A roadway is high above the stream channel and does not apparently impact the riparian zone.

The west fork is very similar to the upper reaches of Elk Creek. It is a Rosgen A type with a seven percent gradient and a V-shaped valley with moderate sinuosity. It too is spring-fed and very stable in its upper reaches. The channel is bedrock with large cobbles and many boulders. Pool development is excellent. There is some riparian degradation in the lower reaches. Also found here is Camp Creek. It is a Rosgen B type with a V-shaped valley, moderate sinuosity and running at a four percent gradient. Some sedimentation has occurred due to a road going through the floodplain and creek.

Current land use in the Bear Creek watershed is primarily recreation and sheep grazing. All or portions of six allotments are contained in the watershed. The stream channel appears to be in a state of instability. This instability is evidenced by a degrading streambed, eroding streambanks, and loss of riparian vegetation. Beaver dams in the watershed are entraining sediment, helping to aggrade the streambed. A pack trail crosses the stream at least 11 times from the trailhead at Bear Creek campground to the confluence with North Fork Bear Creek. The trail shows additional erosion in some steeper locations adjacent to Bear Creek. The pack trail and campground see heavy recreational use.

Big Elk Creek sub-watershed 1704010408

The Big Elk sub-watershed drains 34663.3 acres (54.2 miles^2) or 5.5 percent of the subbasin. Big Elk Creek is the primary stream with its headwaters in Wyoming. There are 75.0 total stream miles which also includes Rabbit Creek, Little Elk Creek, Sheep Creek, South Fork Snake River (portion of reservoir with dam). Big Elk Creek is a

Rosgen type A stream with a V-shaped valley that flows down a five- percent gradient. It is very stable with its banks and channel being composed of fine gravel to course rubble with dispersed boulders. Pool development is good, however it is limited to the areas associated with boulders. Several areas show evidence of slumping with the material being deposited into the channel. In the lower reach, the energy dissipates and more boulders appear accompanied by large cobbles. Pool development is improved in this area. There is a YMCA camp located on this portion of the stream.

Little Elk Creek flows down a five percent gradient with a low sinuosity. It is only two to three inches deep along its entire length, with an intermittent upper portion. There have been historic or annual high water erosional events through the loosely consolidated glacial substrate that have scoured the channel and left the streambed entirely composed of boulder and rubble.

Sheep Creek is a Rosgen type B in a U-shaped valley. It has a three percent gradient and a low sinuosity. This stream averages no more than four to eight inches deep and almost 100 percent surface fines. The flow has been altered by a 55-gallon drum and pipes that have been installed in the streambed. Grazing and recreational impacts have been heavy. The stream disappeared 1.9 miles above the confluence with Palisades reservoir, and is intermittent above this level.

Dry Canyon sub-watershed 1704010402

The Dry Canyon sub-watershed is located on 21087.7 acres (33.0 miles^2) which is 4.1 percent of the subbasin. It is located on the Pine Creek bench adjacent to the South Fork. There are many spring seeps and ephemeral channels, totaling 56.3 stream miles. Flow in these unnamed channels is intermittent and there was no further information available on them.

Fall Creek sub-watershed 1704010405

The primary stream in this watershed is Fall Creek, which gets its name from a 60-foot waterfall that cascades down a travertine deposit. The watershed drains 49748.5 acres (77.7 miles^2) which is 9.7 percent of the subbasin and has a total of 133.3 stream miles. Other streams include Beaver Creek, Haskin Creek, Trap Creek, Camp Creek, Monument Creek, Dune Creek, Trail Creek, Gibson Creek, Porcupine Creek, Horse Creek, South Fork Fall Creek, and East Fork Fall Creek. Fall Creek is a C type Rosgen stream with a V-shaped valley and a low to moderate sinuosity. The upper reaches are spring fed and have gradients to 16 percent, decreasing to two to three percent. A road that crosses the headwaters and several grazing allotments that contribute to elevated sediment levels. There are numerous mineral seeps in the area, which also cause a great conductivity problem. Pool development is good. Where the stream levels out, there is a large beaver complex. This complex forms a series of ponds on the lower portion and multiple channels on the upper portion. Sediment fans occur from blown-out beaver dams. The south fork of Fall Creek is a Rosgen type C with a V-shaped valley and a four percent gradient. The middle section of this stream flows through a meadow setting and has good pool development. The substrate is fine gravels and sand, which is cemented together in some areas forming a conglomerate. There is some beaver activity here also, but the main source of sedimentation is a deeply rutted track that parallels and crosses the stream. Monument Creek is a Rosgen B type with a trough like valley and a five percent gradient. Gibson Creek is a Rosgen type A with a U-shaped valley and a seven percent gradient. Trail Creek is a Rosgen B type that has trough like valley and a three percent gradient. It is a beaver complex throughout.

Indian Creek sub-watershed 1704010410

The Indian Creek sub-watershed begins in Wyoming with North Fork Indian Creek. It covers 46756.7 acres (73.1 miles^2) which is 8.2 percent of the subbasin. There are 112.0 total stream miles, including Spring Run, Trout Creek, Burns Creek, McNeil Creek, Williams Creek, Sulphur Bar Creek, Big Spring Creek, Dan Creek, Dandehole Creek, Landslide Creek, Van Creek and South Fork Snake River including Palisades Reservoir.

Indian Creek is a Rosgen type B stream with a V-shaped valley and moderate sinuosity. The stream is of smaller size, which makes the streambank more susceptible to riparian degradation. The sub-watershed has experienced landslides, filling the channel with sediment. Consequently, a great deal of sediment has been introduced into the channel. The sediment drops out into large fan shaped deposits in the lower reaches. There is also a great deal of beaver activity in the area. Many dams that have failed have also released a lot of sediment. Most of the lower reach is braided and very shallow. The north and south forks have some additional sediment concerns, with greater mass wasting of the banks and more blowouts from failed beaver dams.

Trout Creek is a second order Rosgen type B stream. Riparian vegetation was dominated by willow and dogwood in the upper reach. Grass and forbs are the dominant streambank vegetation downstream, and this vegetation type is a weaker cover for the streambanks, allowing some sloughing. Also located in this sub-watershed is Burns Creek, a second order stream with a Rosgen B channel type. It is a high gradient stream with excellent pool development. The banks and channel are bedrock or large cobbles, although there is a great deal of fine gravel and coarse sand available. Some areas show severe sedimentation from livestock grazing, although there are no allotments on this site. There is also a great deal of human damage in the form of recreational vehicles being run in the stream and up and down the banks. Sulphur Bar Creek is a second order Rosgen type B stream in a tight canyon covered heavily with vegetation throughout the drainage. Riparian vegetation includes thick growths of dogwoods, willows and a variety of forbs and trees. Big Spring Creek is a second order Rosgen type B stream. Similar to Sulphur Bar Creek, it is in a heavily vegetated canyon, with riparian vegetation including thick dogwoods, willows, black hawthorns and a variety of forbs and trees. North Fork Indian Creek is a second order Rosgen type B stream. It is in a V-shaped valley and has downcut through numerous landslide deposits. Apparent bedload deposits and large woody debris are located on terraces above the stream. The substrate consists of large boulders and bedrock. This stream is subterranean below the confluence with South Fork Indian Creek to the reservoir. Only brook trout are found in North Fork Indian Creek, having been planted in the 1940's, and have completely displaced the native cutthroat trout (TNF 2000). Landslide Creek is a second order stream with a Rosgen B channel. The entire length of the stream is in a tight, heavily vegetated canyon with thick dogwoods, willows, hawthorns, and several forb and tree species in the riparian zone. The substrate of the stream consists mainly of cobbles. Van Creek has extremely low flow with almost 100 percent surface fines and supports tremendous beaver activity.

McCoy Creek sub-watershed 1704010411

The McCoy Creek sub-watershed drains 68215.8 acres (106.6 miles^2) or 14.4 percent of the subbasin. There are 196.0 total stream miles which includes McCoy Creek, Biners Creek, Mel Creek, Fish Creek, Barnes Creek, Spring Creek, Pole Creek, Clear Creek, Wolverine Creek, Kirk Creek, Jensen Creek. McCoy Creek is the primary waterway. It is a Rosgen B type stream channel with a U-shaped valley. It flows with a two to four percent gradient over a very stable substrate made up of cobbles with occasional boulders. Fine gravels and coarse sand are present in limited quantities. Pool development is excellent. Historical and current beaver and livestock activity are apparent. The upper reaches show signs of several major disturbances. Mining could possibly have been involved as there are claim signs present or it could have been a series of major flood events. Riparian vegetation consists of thick stands of willows in the upper reach and patches of willows and dogwood in the lower reach. Fish Creek is a C Rosgen channel type that contributes 25 percent of the water volume to McCoy Creek. Fish Creek is in a tight valley, highly vegetated with willows, dogwoods, sagebrush, grasses and forbs. Large woody debris is distributed regularly along the stream. The substrate consists of cobble and gravel. The forest fisheries crew observed extensive damage in the riparian zone from livestock and declared Fish Creek to be the most severely impacted by grazing of any stream investigated in the 2000 cutthroat trout distribution survey report (TNF 2000). Clear Creek is a Rosgen C channel type in a wide U-shaped valley. The Clear Creek riparian zone is filled with thick stands of willow. The stream substrate is generally gravel and sand. Beaver activity is apparent, but very little grazing impacts are observed. About 175 feet upstream of the confluence with Pole Creek, Clear Creek flows to multiple channels for about 300 feet, then returns to one channel. Here, stream velocity increases and more cobbles are apparent on the stream bottom.

Palisades Creek sub-watershed 1704010407

The Palisades Creek sub-watershed drains 64604.2 acres (101.0 miles^2) which is 11.7 percent of the subbasin. It contains 161.0 total stream miles of which Palisades Creek is the main tributary. Also present are the North Fork Palisades Creek, Alder Creek, Russell Creek, Man Creek, Deer Creek. Palisades Creek has a Rosgen A type channel with a V-shaped valley. It is moderate in sinuosity and falls at a four percent gradient. The banks and channel of this stream are predominantly bedrock and boulders. Fine gravels and coarse sands are also dispersed throughout the reach. There are many ponds and spring seeps along the middle section of this stream and pool development is excellent. The lower and upper Palisades lakes are located on this reach and drain into it. The channel of the North Fork Palisades Creek has less large rock material in it and shows a considerable amount of channel cutting. Several landslides have deposited material into the channel. Overall, pool development is still good. This stream slows and widens somewhat and hosts a large willow/alder (*Alnus* sp.) complex, supporting a great deal of beaver activity. Russell Creek and Deer Creek are smaller, higher intensity streams that also feed this system. With seven percent and ten percent gradients respectively, both are Rosgen type A streams with V-shaped valleys and low sinuosities. Both exhibit some head cutting, but overall are stable with good overall pool development. Both share a high potential for aquatic insect production that benefits the trout populations.

Pine Creek sub-watershed 1704010403

The Pine Creek sub-watershed occupies 46679.4 acres (72.9 miles^2) which is 7.2 percent of the subbasin. It contains 98.9 total stream miles with Pine Creek and West Pine Creek being the major tributaries. Other tributaries include Polson Creek, Dry Fork, Carrot Creek, Red Creek, Molten Creek, Elk Flat Fork and Tie Canyon Creek. Pine Creek is a Rosgen B type with a U-shaped valley. It has a 1.4 to 4.4 percent gradient with moderate sinuosity (TNF 1999). The banks and bottom contain large cobbles. Pool structure is excellent. The middle reach of Pine Creek has greater sinuosity, increased meanders, vertical banks, and numerous braids and point bars indicating a depositional zone. Sedimentation is moderate with moderate to heavy embeddedness in glides and pools. In the lower portion, the stream opens onto a large fluvial plain. This greatly improves habitat because of increased pool structures at the bends. Braids and point bars also form more frequently at this point of the system. Increased beaver activity is also evident. West Pine Creek is also a Rosgen type B stream, however, it has a V-shaped valley. At a four percent gradient, it is a slightly higher energy stream with moderate sinuosity. A large cobble and boulder substrate also provides for stable banks and bottom. Pool structure in this stream is good with little or no cutting or sediment deposition. Tie Canyon Creek represents a small high-energy tributary in this system. It also is a Rosgen type B stream with a V shaped valley structure. It has a three percent gradient and some unstable streambanks.

Rainey Creek sub-watershed 1704010406

Rainey Creek sub-watershed encompasses 39269.5 acres (61.4 miles^2) which is 7.4 percent of the subbasin. It contains 102.2 total stream miles with Rainy Creek being the major tributary. North Fork Rainey Creek, South Fork Rainey Creek, Squaw Creek and Halfway Creek make up the other major tributaries. Rainey Creek is a Rosgen type B (TNF 1999) in a U-shaped valley with a gradient of three percent and moderate sinuosity. It is highly influenced by spring seeps and ground water. The substrate tends to be cobbles and boulders. There is fair pool development. Damage to the banks is high due to grazing. This damage is mitigated somewhat by the rocky substrate but a great deal of deposition is taking place. In the upper reach, pool development is poor and there are few overhanging banks or structures. North Fork Rainey Creek is a Rosgen type C in a U-shaped valley. It has a 1.5 percent gradient and moderate sinuosity. The banks and channel are relatively stable but there is some sediment deposition. This reach exhibits good pool structure. Squaw Creek is a Rosgen type A small intermittent tributary in a V-shaped valley. The morphology is altered due to Forest Service roads 058 and 079 (TNF 1999).

Swan Valley sub-watershed 1704010404

The Swan Valley sub-watershed encompasses 42276.8 acres (66.1 miles^2) which is 9.4 percent of the subbasin. The main stream is Pritchard Creek, but also includes Garden Creek, Granite Creek, Papoose Creek for a total of 128.6 total stream miles. Pritchard Creek is a high energy, Rosgen type C stream with a low sinuosity and a gradient of two percent. It is fed by many springs and has a cobble and gravel substrate. Approximately 15 years ago there was a major restoration effort carried out on the lower reach by Trout Unlimited and the Idaho Department of Transportation. The objective was to provide passage for cutthroat trout. Garden Creek is a relatively small, second order Rosgen type B stream in a U-shaped valley with a high-energy runoff regime. It is spring fed and has good pool development and a cobble, gravel and fines substrate. In summer, the water of Garden Creek does not reach the South Fork Snake River due to irrigation utilization on private land. Granite Creek is a Rosgen B type with a trough-like valley. It has moderate sinuosity with a two percent gradient. Pool development is good overall, however, there is some sedimentation from an adjacent roadway as well as trash in the channel and on the banks. Papoose Creek is a small stream located here that often flows subterranean.

In September 1999, the Caribou-Targhee National Forest conducted a prescribed burn in the Pritchard Creek region (TNF 1999b). An unexpected wind event caused the fire to escape the prearranged boundaries until an additional 1600 to 1800 acres burned in Pritchard and Garden Creek drainages. About 300 to 350 of these acres burned intensely enough to totally consume vegetation. Mitigation measures were accomplished in several side drainages of Garden Creek to reduce sediment loads. Other mitigation measures proposed include seeding and eliminating grazing for two growing seasons. Suggested monitoring includes fish surveys, macroinvertebrate monitoring and sediment monitoring (TNF 1999b).

The Caribou-Targhee National Forest (TNF 2000) provided an account of the current condition of Garden Creek in the 2000 cutthroat trout distribution survey reports. The riparian zone had been completely burned in the lower two-thirds of the creek. Lodgepole pine and Douglas-fir had dominated the overstory, with thick alders, hawthorn and willows in the riparian understory. Thistles now dominate the understory in the burned areas, providing little canopy cover and poor streambank stability. Willows and forbs are beginning to regenerate. There is a large amount of large woody debris throughout the stream, consisting of charred logs. Cutthroat trout are well distributed throughout the entire stream. Large woody debris may help reduce the impact of the sediments to the cutthroat trout as the wood provides cover and nutrients for the fish while dissipating stream energy, sorting gravels and scouring pools to improve habitat (TNF 2000).

WATER QUALITY CONCERNS AND STATUS

Water Quality-limited Waters

The proposed 1998 303(d) list for Idaho (IDEQ 1999) designates ten water bodies as water quality limited. These water bodies are listed in Table 8 and depicted in **Figure 9** (IDEQ 1998). The EPA has proposed adding over 92 water bodies to the 1998 Idaho 303(d) list (EPA 2000), primarily for elevated surface water temperatures. None of these occur in the Palisades subbasin.

Table 8. 1998 IDEQ water quality limited segments occurring in the Palisades cataloging unit (17040104).

Water Body (WBID#)	Boundaries	Pollutants
Antelope Creek (2)	State land boundary to SF Snake River	Sediment
Bear Creek (13)	headwaters to NF Bear Creek	Unknown
Camp Creek (6)	headwaters to Fall Creek	Unknown
Elk Creek (11)	headwaters to WF Elk Creek	Unknown
Fall Creek (6)	headwaters to SF Fall Creek	Unknown
Little Elk Creek (26)	headwaters to Palisades Reservoir	Unknown
NF Indian Creek (24)	Wyoming line to Indian Creek	Unknown
Sheep Creek (8)	headwaters to SF Snake River	Unknown
Snake River (8)	Palisades Dam to Irwin	flow alteration
Snake River (1, 3, 8)	Irwin to HUC boundary	flow alteration

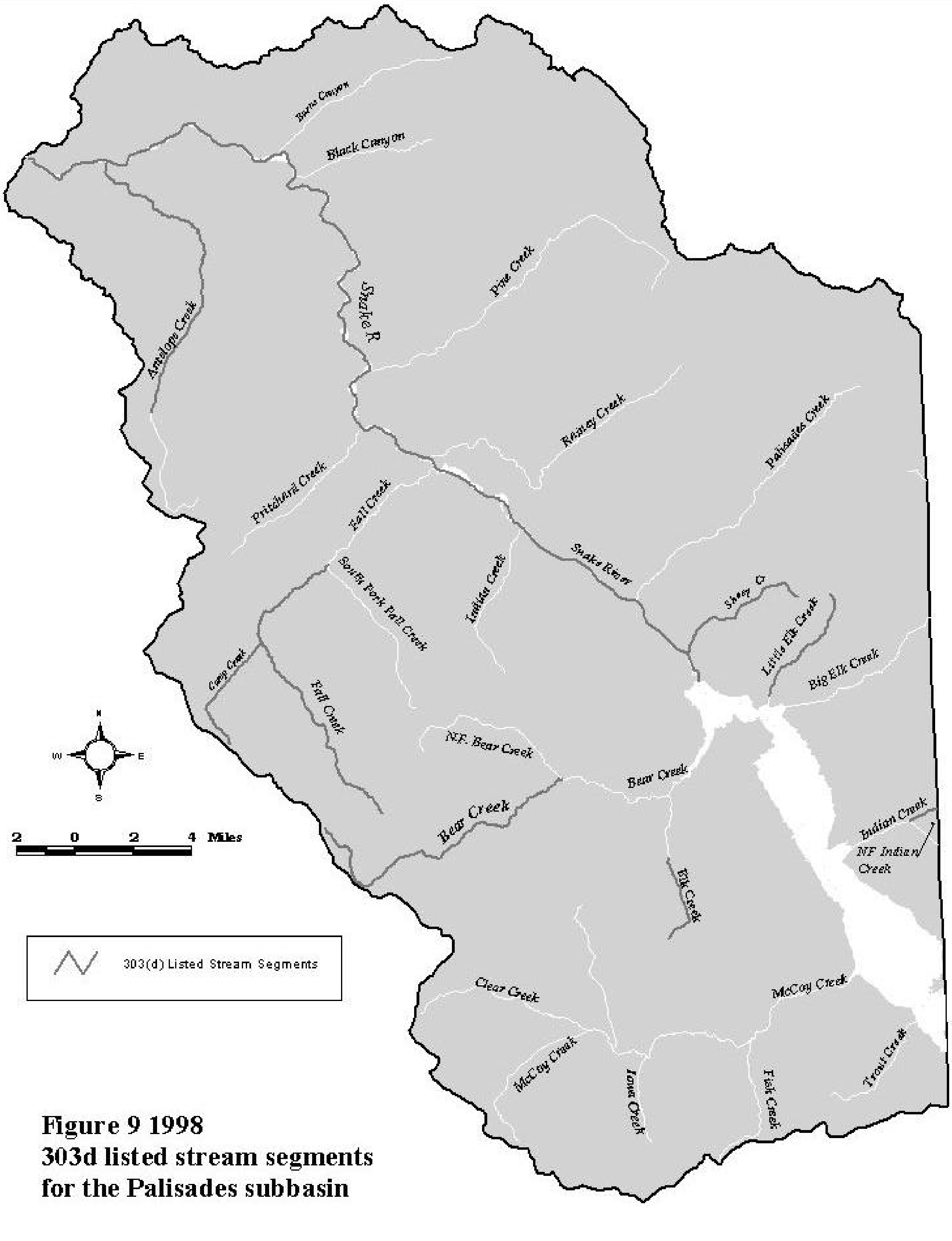

Figure 9 1998
303d listed stream segments
for the Palisades subbasin

Several changes were made from the 1996 list (IDEQ 1997) in the 1998 Idaho 303(d) list. Additions to the Idaho 303(d) list include Bear Creek, Camp Creek, Elk Creek, Fall Creek, Little Elk Creek, North Fork Indian Creek, and Sheep Creek for unknown pollutants. McCoy Creek was removed from the list. The upstream boundary of the listed section of Antelope Creek was changed from the headwaters to the State land boundary (SE 1/4 of the NE 1/4, Sec. 25, T2N, R41E, Lat. 43N 28' 30.54", Long. 111N 34' 0.18").

Listing History

Antelope Creek was designated as a Stream Segment of Concern (Zaroban 1993) due to impairments to cold water biota and salmonid spawning uses and threats to primary and secondary contact recreation (IDEQ 1991) primarily from sediment. These impairments and threats were reported by the IDEQ (Drewes 1991) and the Idaho Department of Lands to result from agricultural and/or grazing activities. The streambanks of some reaches of Antelope Creek were reported to be up to 45 percent unstable (IDEQ 1994). Antelope Creek was first listed as water quality limited on the 1994 EPA 303(d) list for the State of Idaho (EPA 1994).

Bear Creek, Camp Creek, Elk Creek, Fall Creek, Little Elk Creek, and North Fork Indian Creek were listed in 1998 (IDEQ 1999) due to low macroinvertebrate biotic index scores in at least one of the sites sampled on each creek. Sheep Creek was listed in 1998 due to inconclusive macroinvertebrate biotic index scores and failure to collect any fish through electrofishing. No pollutants were associated with these listings.

The South Fork Snake River was designated as a stream segment of concern in 1992 due to agriculture and/or grazing (Zaroban 1993). The South Fork Snake River from Palisades Dam to Heise was first listed as water quality limited on the 1994 EPA 303(d) list for the State of Idaho (EPA 1994) and subsequently on the 1998 Idaho 303(d) list (IDEQ 1999) due to flow alteration.

Flow Alteration

Although flow alteration can adversely affect beneficial uses, there are no Idaho water quality standards or criteria that address it. Flow alteration is not suitable for estimation of load capacity or load allocations and is out of the jurisdiction of IDEQ.

Water Quality Standards

The overall all objective of the Clean Water Act (CWA) is to A...restore and maintain the chemical, physical, and biological integrity of the Nations waters. An interim goal of the CWA is to provide for the " . . .protection and propagation of fish, shellfish, and wildlife and ... for recreation in and on the water. . . , commonly known as the "fishable/swimmable" goal. The CWA requires each state to adopt water quality standards for waters of the state.

Water quality standards for Idaho are published in the state=s rules at *IDAPA 58.01.02* **B** *Water Quality Standards and Wastewater Treatment Requirements*. The standards may also be accessed on the internet at HTTP://www2.state.id.us/adm/adminrules/rules/idapa58/0102.pdf. The primary beneficial uses designated for Idaho waters are in the categories of water supply, aquatic life, and recreation. These beneficial uses are defined below.

Water supply

Agricultural water supply (AWS): water quality appropriate for the irrigation of crops or as drinking water for livestock. This use applies to all surface waters of the State.

Domestic water supply (DWS): water quality appropriate for drinking water supplies.

Industrial water supply (IWS): water quality appropriate for industrial water supplies. This use applies to all waters of the State.

Aquatic life

Cold water biota (CWB): water quality appropriate for the protection and maintenance of a viable aquatic life community for cold water species;

Salmonid spawning (SS): waters that provide or could provide a habitat for active self-propagating populations of salmonid fishes;

Seasonal cold water biota (SCWB): water quality appropriate for the protection and maintenance of a viable aquatic life community of cool and cold water species, where cold water aquatic life may be absent during, or tolerant of, seasonally warm temperatures;

Warm water biota (WWB): water quality appropriate for the protection and maintenance of a viable aquatic life community for warm water species;

Modified (MOD): water quality appropriate for an aquatic life community that is limited due to one or more conditions set forth in 40 CFR 131.10(g) which preclude attainment of reference streams or conditions.

Recreation

Primary contact recreation (PCR): water quality appropriate for prolonged and intimate contact by humans or for recreational activities when the ingestion of small quantities of water is likely to occur. Such activities include, but are not restricted to, swimming, water skiing, or skin diving.

Secondary contact recreation (SCR): water quality appropriate for recreational uses on or about the water and which are not included in the primary contact category. These activities may include fishing, boating, wading, infrequent swimming, and other activities where ingestion of raw water is not likely to occur.

Criteria

Water quality criteria used to protect these beneficial uses include narrative Afree from@ criteria applicable to all waters (IDAPA 58.01.02.200), and numerical criteria that vary according to beneficial uses (IDAPA 58.01.02.250). Typical numeric criteria include bacteriological criteria for recreational uses, physical and chemical criteria for aquatic life (e.g. pH, temperature, dissolved oxygen (DO), etc.), and toxics and turbidity criteria for water supplies. Designated and known existing beneficial uses for waters in the Palisades subbasin are listed in Table 9.

Table 9. Designated and existing beneficial uses for water bodies of the Palisades subbasin (17040104) as described in the Idaho water quality standards April 5, 2000.

Water Body	WBID	Boundaries	Designated	Existing
Antelope Creek	US-2	source to mouth	none	CWB, SS
Bear Creek	US-11	NF Bear Creek to Palisades Reservoir	none	CWB, SS
Bear Creek	US-13	source to NF Bear Creek	none	CWB
Big Elk Creek	US-25	Wyoming border to Palisades Reservoir	none	CWB, SS, PCR
Black Canyon Creek	US-30	source to mouth	none	CWB, SS
Burns Creek	US-23	source to Wyoming border	none	CWB, SS
Burns Canyon Creek	US-31	source to mouth	none	CWB, SS
Clear Creek	US-18	source to mouth	none	undocumented
Fall Creek	US-5	SF Fall Creek to mouth	none	CWB, SS

Water Body	WBID	Boundaries	Designated	Existing
Fall Creek	US-6	source to SF Fall Creek	none	CWB, SS
Fish Creek	US-21	source to mouth	none	undocumented
Indian Creek	US-9	source to mouth	none	CWB, SS
Indian Creek	US-24	Wyoming border to Palisades Reservoir	none	CWB-App. F
Iowa Creek	US-20	source to mouth	none	undocumented
Little Elk Creek	US-26	source to Palisades Reservoir	none	CWB-App. F
McCoy Creek	US-14	Fish Creek to Palisades Reservoir	none	CWB, SS
McCoy Creek	US-15	Iowa Creek to Fish Creek	none	CWB, SS
McCoy Creek	US-16	Clear Creek to Iowa Creek	none	CWB, SS
McCoy Creek	US-19	source to Clear Creek	none	CWB, SS
North Fork Bear Creek	US-12	source to mouth	none	undocumented
Palisades Creek	US-27	source to mouth	none	CWB, SS
Palisades Reservoir	US-10	none listed	CWB, SS, PCR, DWS, SRW	CWB, SS, PCR, DWS, SRW
Pine Creek	US-29	source to mouth	none	CWB, SS
Pritchard Creek	US-4	source to mouth	none	CWB, SS
Rainey Creek	US-28	source to mouth	none	CWB, SS
Snake River	US-1	Black Canyon Creek to river mile 856 (T3N, R41E, Sec. 16)	CWB, SS, PCR, DWS, SRW	CWB, SS, PCR, DWS, SRW
Snake River	US-3	Fall Creek to Black Canyon Creek	CWB, SS, PCR, DWS, SRW	CWB, SS, PCR, DWS, SRW
Snake River	US-8	Palisades Reservoir Dam to Fall Creek	CWB, SS, PCR, DWS, SRW	CWB, SS, PCR, DWS, SRW
South Fork Fall Creek	US-7	source to mouth	none	undocumented
Trout Creek	US-22	source to mouth	none	CWB, SS
Wolverine Creek	US-17	source to mouth	none	CWB, SS

Sediment is of particular importance regarding Antelope Creek in this subbasin. The narrative, or Afree from@, criterion for sediment is as follows:

> ASediment shall not exceed quantities specified in section 250 and 252, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses. Determinations of impairment shall be based on water quality monitoring and surveillance and the information utilized as described in section 350.@

Quantities specified in Section 250 refer to turbidity criteria identified for cold water biota use and, in Section 252, small public domestic water supplies. Indirectly, specific sediment criteria also include intergravel dissolved oxygen measures for salmonid spawning uses.

Water Body Assessments

The data sources examined for water quality information in the Palisades subbasin include beneficial use reconnaissance project data, US Geological Survey chemical data, TNF ecological assessments, the State Agricultural Water Quality Program (SAWQP) analyses of the Antelope-Pine Creek Watershed, the USGS National Water Quality Assessment Program (NAWQA), and the IDEQ upper Snake River Basin status reports from years 1989, 1991 and 1994.

<u>Beneficial use reconnaissance project assessments</u>

Water quality data for Palisades subbasin has been collected and assessed primarily through the IDEQ beneficial use reconnaissance project (BURP). Data for 51 sites on 34 streams assessed in 1996 are presented in Appendix A. Most of the assessed streams are first or second order streams with Rosgen channel types A or B. Elevations of the BURP sites range from 4840 feet at Squaw Creek to 7120 feet at a Fall Creek site. Percent fines ranges from 19 percent at Bear Creek and Big Elk Creek to 100 percent at Monument Creek. Width-to-depth ratios range from 2.1 found at Booth Canyon Creek to 65.4 at an Indian Creek site. Bank stability averages 69 to 70 percent, and vegetative cover of the stream banks averages 80 to 81 percent (IDEQ 1996).

The macroinvertebrate assemblage is assessed in a biotic integrity report (Clark 2000) which is included as Appendix B. This assessment developed from 1996 BURP data indicates that the seven streams listed for unknown pollutants may be impacted by fine sediment. Additionally, Little Elk Creek may be impacted by temperature.

The IDEQ determines whether a water body is fully supporting its designated and existing beneficial uses. Biological and aquatic habitat parameters are used as a guide to determine support status of the water body. A stream that becomes listed according to '303(d) of the Clean Water Act is not considered to be in full support of its beneficial uses and does not meet state water quality standards. A stream is removed from the 303(d) list only when it becomes able to support its beneficial uses. Table 10 summarizes IDEQ 1997 determinations of beneficial use support status for the 303(d) listed streams in Palisades subbasin. For numeric criteria, there is no available data at the time of this writing in the water body assessments.

Table 10. Support status of beneficial uses of 1998 303(d) Listed Waters.

Water Body (WBID#)	Designated Beneficial Use	Existing Beneficial Use	Support Status	Comments
Antelope Creek (2)		CWB	Not Full Support	No fish data.
		SS		
Bear Creek (13)		CWB	Not Full Support	Electrofished September 1996, fish collected.
Camp Creek (6)		CWB	Not Full Support	No fish data.
		SS		
Elk Creek (11)		CWB	Not Full Support	Electrofished August 1996, fish collected.
		SS	Full Support	
Fall Creek (6)		CWB	Not Full Support	Electrofished August 1996, fish collected.
		SS	Full Support	
Little Elk Creek (26)		CWB	Not Full Support	No fish data.
NF Indian Creek (24)		CWB	Not Full Support	No fish data.
Sheep Creek (8)		CWB	Needs Verification	Electrofished August 1996, no fish collected.
	SCR		Not Assessed	
Snake River (8)	CWB	CWB		River BURP data has not been collected in Palisades Subbasin
	SS	SS		
	PCR	PCR		
	DWS	DWS		
	SRW	SRW		
Snake River (1, 3, 8)	CWB	CWB		River BURP data has not been collected in Palisades Subbasin
	SS	SS		
	PCR	PCR		
	DWS	DWS		
	SRW	SRW		

Beneficial Uses: CWB=cold water biota, SS=salmonid spawning, PCR=primary contact recreation, DWS=domestic water supply, SRW=special resource water.

USGS chemical data

The USGS has collected extensive water quality data at the South Fork Snake River station near Heise from the 1970s through the early 1990s, including information on temperature, fecal coliform, dissolved oxygen, and sediment. The mean water temperature has been 45^{N}F (7.3^{N}C), with a maximum temperature of 73.4^{N}F (23^{N}C) and a minimum of 32^{N}F (0^{N}C). Fecal coliform colonies measured via the membrane filter method averaged 7.94 per 100 ml. The dissolved oxygen has ranged from 7.8 to 13.6 mg/l, with a mean of 10.417 mg/l. The percent saturation of dissolved oxygen has ranged from 74 to 126 percent, and the mean was 98.975 percent. Information regarding sediment includes turbidity readings averaging 3.24 from Hach^{7} turbidimeter. An average 72 percent of the suspended sediment particles were less than 0.062 mm. Total suspended sediment discharged at a mean rate of 476 tons per day. From 1953 to 1983, dissolved solids were measured at an average 4,023.7 tons per day, or 0.3347 tons per acre/feet (USGS 2000).

National forest assessments

The Forest Service in the Palisades subbasin has not performed any water quality monitoring projects. Targhee National Forest did an extensive ecological unit inventory for all of the vegetation types throughout the forest, but this includes no water quality data (TNF 1997b and 1997c). The Idaho Falls District BLM and Targhee National Forest performed a cooperative environmental assessment along the South Fork corridor, but no water quality monitoring was performed for this effort (BLM and TNF 1991).

State agricultural water quality program assessments

The East Side Soil and Water Conservation District initiated water quality monitoring for the Antelope-Pine Creek watershed in the 1988-1989 water season (Drewes 1991). This area covers the portion of the Palisades subbasin downstream of the dam. Instantaneous samples were collected twice a month. Suspended sediments showed a marked increase from sites upstream to sites lower in the watershed, even during a low-flow drought year. Average suspended sediments ranged from 3 mg/l on the South Fork at Palisades to a downstream level of 30 mg/l at Heise. The highest average levels were found at Antelope Creek, with 283 mg/l suspended sediments and at Granite Creek, with 853 mg/l. Water quality standards for fecal coliform were exceeded once at Granite Creek and on three occasions at Lower Rainey Creek. The abatement plan for the Antelope-Pine Creek area recommended further similar water quality data collection and the establishment of a monitoring station at the Caribou National Forest boundary on a representative creek in order to establish base information (East Side Soil and Water Conservation District 1989).

National water quality assessment program summary

Surface water data from the USGS NAWQA program was compiled and analyzed for the entire upper Snake River basin, of which Palisades subbasin is a small part in the east-central region of the larger basin. A 1994 report analyzing the constituents of the surface water shows that mass movement of sediment in the upper Snake River basin is controlled mainly by changes in the streamflow due to dams and diversions. The main cause to changes in natural water quality is reported as irrigated agriculture. Other factors include rangeland grazing and recreation (Clark 1994). The 1995 NAWQA (Maret 1995) report summarizing aquatic biological data in the upper Snake River basin reports nonpoint source pollution as the main influence on surface water quality. The major human activities in the basin that affect aquatic life are stream alterations, irrigated agriculture, grazing, and species introductions. The beneficial uses that these activities affect are mainly cold water biota, salmonid spawning and primary contact recreation. A 1997 NAWQA report (Maret 1997) compares reference stream sites to those affected by agriculture. Median percent substrate fines and percent embeddedness were significantly higher in agricultural streams than in reference sites.

Upper Snake River basin status reports

Reports from the basin area meetings in the upper Snake River basin have summarized the efforts of each agency to support the antidegradation policy by maintaining and protecting the existing beneficial uses of the waterbodies under their management (IDEQ 1989, 1991 and 1994). The first meeting after the antidegradation agreement was implemented was held between IDEQ and the Idaho Department of Fish and Game (IDFG). For the South Fork watershed, it was simply reported that agricultural runoff from both irrigated and non-irrigated farming was impacting the river (IDEQ 1989).

Another upper Snake River basin status session was held in 1991. The Idaho Department of Fish and Game had sampled fish in Antelope Creek and McCoy Creek. No fish were found in the sample location of Antelope Creek and this was attributed to poor habitat. McCoy Creek was reported to be an important spawning and rearing tributary for cutthroat trout, with densities from 30 to 50 fish per 100 meters. The Soil Conservation District monitored McCoy Creek and found that livestock grazing, road construction and recreation had more effect on instream water quality than timber harvesting. A state agricultural water quality project was in the process of being implemented for Antelope Creek (IDEQ 1991).

By 1994, agency reports included the Soil Conservation District continuing implementation of the project on Antelope Creek. IDEQ monitoring at this time found that the banks of the upper reach of Antelope Creek were about 45 percent unstable, showing moderate grazing activity, recreational use, and several beaver complexes. The lower IDEQ monitoring site was dewatered. The IDFG studied the South Fork in the Palisades subbasin and recommended a minimum winter flow of 1,500 cubic feet per second from Palisades Dam to improve winter habitat availability and utilization by juvenile cutthroat trout, brown trout and mountain whitefish (IDEQ 1994).

Assessment Data Gaps

Fish

Salmonid spawning needs to be assessed in Antelope Creek and Camp Creek. The designated and existing beneficial uses for the South Fork Snake River from Palisades Dam to the HUC boundary need to be assessed.

POLLUTANT SOURCE INVENTORY

Palisades subbasin has no national pollution discharge elimination system (NPDES) permits located within its boundaries. There are no confined animal feeding operations (CAFOs). There are no known point sources, therefore, no wasteload allocation will be developed. The Palisades subbasin has 10 water bodies listed on the 1998 303(d) list. The South Fork Snake River is listed for flow alteration from Palisades Dam to the HUC boundary. The state of Idaho has no standards established for flow alteration and will therefore not be developing a load allocation for this parameter. It should also be noted that under the heading of nonpoint source pollution, virtually every reference examined (TNF 1980, East Side Soil and Water Conservation District 1989 and IDEQ 1996) on these 5th field HUCs mentioned streambank disturbance and sedimentation. Activities reported in these areas include livestock, roads and trails traversing the streambanks, recreational vehicles in the streams and riparian areas, failing culvert/road systems, bare compacted streambanks at campsites and, to a much lesser degree, areas that are recovering from fires.

Antelope Creek

Antelope Creek is listed for sediment from the state land boundary (SE 1/4 of the NE 1/4, Sec. 25, T2N, R41E, Lat. 43^{N} 28' 30.54", Long. 111^{N} 34' 0.18") to the South Fork Snake River (note Table 8). Within the drainage of the listed section of Antelope Creek, land use is 91 percent dryland agriculture and nine percent forest (Idaho Department of Water Resources 1990 1:500,000 coverage). Land ownership is 97 percent private and three percent state of Idaho (BLM 1975-1992 1:100,000 coverage).

The Idaho agricultural pollution abatement plan (East Side Soil and Water Conservation District 1991) targets non-irrigated cropland as a critical nonpoint source of water pollution due to the highly erodible character of the soils in the Antelope Creek drainage. Data from the IDEQ beneficial use reconnaissance project reports 36.4 percent bottom substrate fines collected from an upper Antelope Creek location on forest land (above the listed section) in the summer of 1994 (IDEQ 1994). Streambank stability at the upper location ranges from 40 to 45 percent unstable. Data collected during the summer of 1995 at a lower site within the listed section showed 70.2 percent bottom substrate fines (IDEQ 1995). Streambank stability at the lower site ranges from 90 to 95 percent unstable. These data indicate much of the instream surface fines may be riparian in origin.

Bear Creek

Bear Creek is currently listed for pollutants unknown from its headwaters to the North Fork Bear Creek. The IDEQ collected streambank stability data and substrate particle size data in Bear Creek below the North Fork Bear Creek in 2000. Streambank stability for Bear Creek below the North Fork was estimated to be 68 percent, delivering an estimated 790 tons/year of sediment to the creek. Bear Creek will therefore be listed for sediment from the headwaters to Palisades Reservoir. Land ownership is 100 percent U.S. Forest Service.

Pollutant Source Data Gaps

The IDEQ conducted additional surveys during the development of the subbasin assessment and the Antelope and Bear Creek sediment load allocations. These surveys addressed the prior pollutant source data gaps.

Summary of Pollution Control Efforts

Past pollution control efforts on private lands of the Palisades watershed have been targeted to controlling sediments from non-irrigated cropland and irrigated cropland with greater than four percent slopes. Sediment from these agricultural sources has been identified as the primary threat to the water quality. Pollution control efforts are prescribed to reduce sediment discharge to potentially affected streams (East Side Soil and Water Conservation District 1989 and 1991).

Pollution control efforts on public lands have been geared towards managing livestock grazing and recreational activities. These pollution control efforts have been directed toward maintaining the integrity of streambanks and reducing sediment loading (BLM and TNF 1991 and TNF 1997a).

<u>Swan Valley irrigation project</u>

At the request of the East Side Soil and Water Conservation District, the Soil Conservation Service prepared a preliminary investigation (SCS 1994) intended to improve delivery of irrigation water on lands served by Palisades and Rainey Creeks and to improve fishery habitat of these creeks and the South Fork Snake River. The main problem was that losses in irrigation water prevented a full season of irrigation to Swan Valley agricultural lands and tended to dewater Rainey Creek during critical fish passage periods. Flows were insufficient to flush sediments in the lower Rainey Creek channel. Application for a USDA PL 566 small watershed program was recommended for Rainey Creek. The goal was to maintain a flow of 10 cubic feet per second to create a functioning salmonid spawning and rearing stream (SCS 1994). This project was never implemented. The preliminary investigation determined that any pollution control efforts for Palisades Creek would not be economically feasible to administer. On Rainey Creek, no support was received to begin this pollution control effort (Hadley 2000).

<u>Antelope-Pine Creek watershed agricultural pollution abatement plan</u>

The Idaho state agricultural water quality program sponsored cost-sharing for crop treatment alternatives based upon water quality monitoring in the Antelope-Pine Creek watershed. Best management practices were detailed for area farmers in order to control and reduce release of sediment, nutrients, bacteria and farm chemicals into the watershed (East Side Soil and Water Conservation District 1991).

At the time of this writing, 75 percent of the private lands adjoining Antelope Creek are under contract with the conservation district, with 67 percent of that land having fully implemented prescribed pollution control techniques. The local conservationist considers that sediment from agricultural runoff is under control for the upland regions of Antelope Creek (Hadley 2000).

<u>Granite Creek implementation project</u>

Granite Creek contributes significantly to the water quality of the South Fork Snake River. Irrigation diversions are common from Granite Creek. It was planned to install best management practices on private lands in the Granite Creek sub-watershed through the cooperative efforts of 29 private landowners. Pollution control would be based upon land treatment and implementation schedules outlined in voluntary contracts between the landowners and the conservation district (East Side Soil and Water Conservation District 1995).

Half of the private lands adjoining Granite Creek are currently under contract. 75% of the remaining croplands are scheduled to be under contract by the end of 2001 (Hadley 2000).

<u>Snake River activity/operations plan: environmental assessment</u>

Lands along the corridor of the South Fork Snake River from Palisades Dam downstream to Henry's Fork are under management combined between Idaho Falls District BLM and the Targhee National Forest. The environmental assessment addresses management control on livestock grazing to reduce suspended sediment entering the South Fork from adjoining public lands. Alternative management scenarios address limitation of livestock utilization of upland vegetation as well as riparian vegetation. Additionally, these agencies are encouraging best management practices to reduce potential sediment loading from lands returning to cultivation out of the conservation reserve program (BLM and TNF 1991).

Targhee National Forest 1997 revised forest plan

The Targhee National Forest advocates management strategies to maintain streambank integrity and to control adverse effects on aquatic and riparian species. The forest will inventory and ensure the compliance of all existing roads and stream crossings that may impact any perennial or intermittent streams. Management goals for the South Fork Snake River relate mainly to preservation of critical habitat and the maintenance of scenic and recreation values. These goals are implemented by restricting cross-country travel of motorized vehicles (TNF 1997a).

RECOMMENDATIONS AND CONCLUSIONS

Palisades subbasin has no national pollution discharge elimination system (NPDES) permits located within its boundaries. There are no confined animal feeding operations (CAFOs). There are no known point sources, therefore, no wasteload allocation will be developed for any 303(d) listed waters.

During the evaluation phase of the Palisades subbasin assessment, the watershed appraisal of 303(d) listed streams indicates many correct management decisions have been made by the USFS, BLM, NRCS, East Side Soil and Water Conservation District, and private landowners. Antelope Creek and Bear Creek each will have a total maximum daily load (TMDL) calculated for sediment. The listed segments of Fall Creek and Camp Creek will be deferred until the year 2006 for calculation of TMDLs. Little Elk Creek and North Fork Indian Creek will be removed from the 303(d) list due to natural hydrological conditions that cannot be managed by human activities. Elk Creek will be removed from the 303(d) list because this watershed is not impacted by human activities. Sheep Creek will be removed from the 303(d) list because it is supporting cold water biota, and is not wide enough or deep enough to support salmonid spawning.

Sediment Load Allocations

<u>Antelope Creek</u>

A sediment load allocation has been calculated for Antelope Creek (**see page 60**). The1998 Idaho 303(d) list (IDEQ 1999), the water quality impacted boundaries of Antelope Creek are from the State land boundary to the South Fork Snake River. However, a streambank erosion inventory performed on October 4, 2000 by IDEQ indicated that the upper boundary should be extended onto land managed by the Targhee National Forest, Palisades Ranger District. The streambank erosion inventory methods and results are referenced in Appendix C. A culvert located at N 43° 27.282' W 111° 33.490' has repeatedly washed out and contributes significantly to the riparian damage of the upper portion of Antelope Creek by initiating a head cut. The IDEQ is extending the upper boundary of the listed segment of Antelope Creek to this location. The IDEQ is amending the pollutant of concern for the lower segment of Antelope Creek to flow alteration because the primary factor limiting the beneficial uses is a dam on private land that dewaters the stream. Although this flow alteration adversely affects the beneficial uses of Antelope Creek from the dam to the confluence of the South Fork Snake River, there are no Idaho water quality standards or criteria that address it. Flow alteration is not suitable for estimation of load capacity or load allocations and is out of the jurisdiction of IDEQ. Therefore, no load allocation will be developed for Antelope Creek from the dam to the confluence with the South Fork Snake River.

<u>Bear Creek</u>

A sediment load allocation has been calculated for Bear Creek (**see page 62**). On the1998 Idaho 303(d) list (IDEQ 1999), the water quality impacted boundaries of Bear Creek are from the headwaters to the North Fork Bear Creek. The IDEQ is extending the impacted boundaries of Bear Creek from the headwaters to Palisades Reservoir. Although Bear Creek had been listed for unknown pollutants, sediment is identified as the pollutant. Investigations to identify the pollutant included a streambank erosion inventory and subsurface fine sediment sampling referenced in Appendix C.

Three sites were assessed on Bear Creek under the IDEQ BURP program in 1996, resulting in a very high macroinvertebrate index score for the lower site and a low score indicating impaired water quality for an upper site. A survey of the upper Bear Creek region indicates that the upper BURP site is representative of the region, but the low macroinvertebrate index score results from sheep grazing. Signs of moose, deer and elk are also apparent. Beaver dam activities appear to entrain most of the sediment input. There is no timber logging, and most of the drainage flows through roadless areas. The one road that crosses the upper Bear Creek drainage has a well-maintained culvert over a first order tributary to Bear Creek. The road crossing contributes no significant sediment to the creek.

TMDL Deferrals

Fall Creek Drainage

Camp Creek and the listed segment of Fall Creek will be deferred until the year 2006 for TMDL development to gather more information. Camp Creek is a first order stream tributary to Fall Creek. The listed segment of Camp Creek is from its headwaters to the confluence with Fall Creek. The listed segment of Fall Creek is from its headwaters to West Fork Fall Creek, leaving the lower portion of Fall Creek unlisted. This creek was an addition to the original court settlement concerning the State's TMDL progress. Streams added after the settlement can be deferred to the end of the schedule.

Water quality and fish habitat along the unlisted segment of Fall Creek is highly impacted by land use. Stream bank erosion is increasing with reduction in cover provided by willows and other riparian vegetation. Riparian vegetation could recover with proper management throughout the riparian zone. The IDEQ will place the entire length of Fall Creek on the State's 303(d) list and draft a TMDL for the entire watershed in 2006, when IDEQ has met its court deadlines for development of other TMDLs.

South Fork Fall Creek is currently not on the 303(d) list. While beneficial uses are being supported, many off-road vehicle trails crisscross the creek, contributing sediment to the creek where it is transported to Fall Creek. The Forest Service has made efforts to reduce road density in the riparian areas. Continued management of this drainage to improve water quality will reduce the potential for water quality impairments, which could lead to a 303(d) listing and TMDL development in the future.

Stream Segment Removals

North Fork Indian Creek

North Fork Indian Creek will be removed from the Idaho 303(d) list. The conclusion to remove this stream is based on an evaluation by IDEQ in October 2000 as well as all assessment results previously reported in this subbasin assessment.

North Fork Indian Creek is a subterranean stream. Most of the listed portion flows below the surface of the channel half of every year. This directly coincides with Rosgen's definition of a subterranean stream channel, which "flows parallel to and near the surface for various seasons – a subsurface flow which follows the stream bed" (Rosgen 1996 p. 6-17). Every summer and fall, the stream flows subsurface from the confluence of North and South Fork Indian Creek to the reservoir (TNF 2000).

Idaho Water Quality Standards discuss application of standards to intermittent waters in IDAPA 58.01.02.070.07, which states,

> **07. Application of Standards to Intermittent And Ephemeral Waters.**
> Water quality standards apply to intermittent waters during optimum flow periods sufficient to support the uses for which the water body is designated. For recreation and water supply uses, optimum flow is equal to or greater than five (5) cubic feet per second (cfs). For aquatic life uses, optimum flow is equal to or greater than one (1) cfs.

Intermittent water is defined as "*[a] stream, reach, or waterbody which has a period of zero (0) flow for at least one (1) week during most years. Where flow records are available, a stream with a hydrologically-based flow of less than one-tenth (0.1) cfs is considered intermittent. Streams with natural perennial pools containing significant aquatic life uses are not intermittent*" IDAPA 58.01.02.003.51.

The channel of North Fork Indian Creek exhibits evidence of instability, including bed scour to bedrock, downcutting through numerous landslide deposits, deposited bedload and large wood on terraces above the stream, and a reach that flows below the surface. Annual high water events have channelized the flow into an erosional type of ephemeral gully. In some locations, the erosional rubble deposited along the streambanks is evidence of apparently catastrophic acceleration of bank erosion. The highly erosional nature of the stream is a natural condition due to high-energy spring runoff events that experience very little dissipation discharging directly down the mountain and into the reservoir (TNF 2000).

The geology of the North Fork Indian Creek drainage contributes to the likelihood of massive erosional events. The drainage had been subject to repeated episodes of glaciation (Alt and Hyndman 1989), leaving a U-shaped valley with rounded rocks in a loosely consolidated glacial till and highly erodible soil (SCS 1981, Merigliano 1996). This rounded, loosely packed material is relatively easy to move during high water episodes. The large rock rubble also contributes to the reason for the subterranean flow.

There are no observable human management issues in the North Fork Indian Creek drainage. All observed conditions appear to be natural characteristics of the drainage. There is no visible fish habitat and no available fish passage from the reservoir due to a perched double culvert. The intermittent and subterranean nature of the water in the stream channel means that no load allocation is reasonable or practical. There is no evidence of use impairment because uses cannot be assessed under such circumstances. Because these are natural conditions and there are no observed human impacts creating the erosional character of the stream channel, IDEQ will remove North Fork Indian Creek from the Idaho 303(d) list.

Little Elk Creek

Little Elk Creek will be removed from the Idaho 303(d) list. This conclusion is based on an October 2000 IDEQ evaluation as well as all assessment results previously reported in this subbasin assessment.

Little Elk Creek has similar hydrology and geology to North Fork Indian Creek, being highly erosional due to natural conditions. High water erosion events have scoured the channel and left the streambed entirely composed of boulder and rubble substrate. High-energy spring runoff events experience very little dissipation discharging directly down the mountain and into the reservoir, leaving evidence of depositional erosion. The Little Elk Creek drainage has been geologically impacted by repeated glaciation. The slopes are full of glacial till and the soil on the valley bottom is composed of loosely consolidated glacial rubble and highly erodible soil (SCS 1981, Alt and Hyndman 1989, Merigliano 1996). This rounded, loosely packed material is relatively easy to move during high water episodes.

The stream is only two to three inches wide along its entire length. The upper portion of the stream is intermittent. See page 58 for a discussion of the application of water quality standards to intermittent waters. There are no visible areas to support salmonid spawning, with no apparent fish passage and no visible habitat to support self-sustaining populations of salmonids.

There are no observable human management issues in the Little Elk Creek drainage. All observed conditions appear to be natural characteristics of the drainage. The intermittent nature of the water in the upper reach reduces the ability to assess or protect aquatic life beneficial uses. Because these are natural conditions and there are no observed human impacts creating the erosional character of the stream channel, IDEQ will remove Little Elk Creek from the Idaho 303(d) list.

Sheep Creek

Sheep Creek will be removed from the Idaho 303(d) list. This conclusion is based on an October 2000 IDEQ evaluation as well as all assessment results previously reported in this subbasin assessment.

Sheep Creek is a very small stream, approximately four to eight inches wide. On May 31, 1996 during a reconnaissance survey, the upper site at 5750 feet in elevation was measured at 0.9 cubic feet per second (cfs) streamflow and the lower site at 5720 feet was measured at 0.2 cfs. Such low flow during May when snowmelt runoff conditions should be occurring suggests that the stream is intermittent. See page 58 for a discussion of the application of water quality standards to intermittent waters. Full biological communities are not attainable at this flow. Intermittent waters require an optimum flow greater than one cfs to support aquatic life uses, and Sheep Creek is apparently not attaining sufficient flow.

Sheep Creek will be removed from the 303(d) list because of its intermittent nature and extremely low flow. Water quality standards do not apply in this instance.

Elk Creek

Elk Creek will be removed from the Idaho 303(d) list. This conclusion is based on an October 2000 IDEQ evaluation as well as all assessment results previously reported in this subbasin assessment.

Two out of three macroinvertebrate sites had very high index scores (4.7 and 5.2), indicating that water quality is not impaired. These sites are lower in the watershed at 6120 and 5800 feet in elevation. A third headwater site had a macroinvertebrate index score of 1.6. The creek at this site is a first-order stream just above a tributary and was sampled June 4 in high flow conditions. The photo taken of the sample site shows a bankfull, high-energy flow, which may have affected the macroinvertebrate sample. The biotic integrity report in Appendix B indicates that fine sediment associated with the high flow may have been impacting this site at the time of sampling, and that the sample size is very low.

There is no evidence of streambank degradation in the Elk Creek drainage. The road through the Elk Creek watershed is not located within the riparian zone. The listed portion of the Elk Creek watershed has been sheep grazed since at least 1922. Written management records for earlier dates are unavailable. The Elk Mountain allotment currently permits grazing of 1800 dry ewes from September 1 to September 10. The Poker Peak allotment permits grazing by 1000 ewe/lamb pairs from July 1 to August 31. There is no evidence that grazing has impacted the streambanks.

The 1996 fish data from IDEQ indicates the creek supports at least three age classes of Yellowstone cutthroat trout including juveniles (see Table 7).
Cold water biota and salmonid spawning are fully supported. In light of these data, the IDEQ is removing Elk Creek from the 303(d) list.

ANTELOPE CREEK SEDIMENT TMDL

Load Capacities and Targets

The sediment load that can be assimilated by Antelope Creek and still meet the State's water quality narrative sediment criteria is unknown. The designated beneficial uses for Antelope Creek are cold water biota and salmonid spawning. These beneficial uses are impacted by sediment loading above the assimilative capacity of the creek. The loading capacity lies somewhere between the current loading level and the sediment loading from natural streambank erosion levels. Cold water biota and salmonid spawning are naturally occurring beneficial uses in Antelope Creek (note Table 7). We therefore assume that cold water biota and salmonid spawning would be fully supported at natural background sediment loading rates. We also assume that natural streambank stability was equal to or greater than 80 percent (Overton et al. 1995). When beneficial uses are met, the levels of streambank stability and depth fines will be used as benchmarks for use support through out the Palisades HUC.

The goal of this TMDL is to improve the quality of spawning and incubation substrate and rearing habitat for Yellowstone cutthroat trout in Antelope Creek. The strategy in this TMDL will be to establish a declining trend in sediment loading, and to regularly monitor the sediment load and beneficial use support. The sediment target for this TMDL will be the percentage of subsurface fine (less than 0.25 inches diameter) sediment. The percentage of subsurface fine sediment is determined using a modified McNeil (McNeil and Ahnell 1964) sediment sampling technique. This technique is described in Appendix C. Two sites were sampled for sediment on Antelope Creek in summer 2000 (**see results pages C-11 and C-12**). The upper watershed site located on Forest Service land had a mean 27 percent subsurface fine sediment. The lower site located on private property had a mean 46 percent subsurface fine sediment.

Other parameters for subsurface fines can affect salmonid production. Chapman (1988) suggested that fine sediment less than 0.03 inches in diameter is most responsible for suffocation and abrasion of salmonid eggs. Tappel and Bjornn (1983) report that sediment less than 0.37 inches in diameter can create a survival barrier preventing salmonid fry emergence from the redd. Hall (1986) found survival (eyed-egg to emergence) of coho, chinook, and chum salmon to be only 7 to 10 percent in gravel mixtures made up of 10 percent fines as compared to 50 to 75 percent survival in gravel mixtures with no fines less than 0.03 inches. Reiser and White (1988) observed little survival of steelhead and chinook salmon eggs beyond 10 to 20 percent fines less than 0.03 inches. These sediment particle size parameters should be considered as part of target monitoring to evaluate any significant shift in subsurface fine particle frequency distribution.

The subsurface fine sediment target for Antelope Creek is less than or equal to 28 percent fine (0.25 inches) sediment, not including sediment particles larger than 2.5 inches, in areas suitable for salmonid spawning. It is also anticipated that the amount of habitat suitable for salmonid spawning will increase after implementation of management practices identified to reduce subsurface fine sediment. Subsurface fine sediment and salmonid age class structure will be monitored bi-annually beginning at completion of the initial implementation phase. By the completion of the third monitoring period, if the percentage of subsurface fine sediment is not decreasing, additional management practices will be applied to attain the target.

Load Allocation

The sediment load allocation for Antelope Creek is developed from a streambank erosion inventory conducted by the IDEQ in October 2000. The inventory confirms earlier reports listed in the sub-watershed descriptions and shows that the primary source of sediment is from streambank erosion. The road crossing at the upper boundary of the listed stream segment and water gaps for livestock also contribute to the sediment load. Streambanks within the listed segment of Antelope Creek were found to be 38 percent erosive. Streambank erosion has been accelerated by degraded riparian conditions from livestock grazing. Reduction of stream bank erosion is directly linked to the improvement of riparian vegetation density and structure as well as improved maintenance of the road crossing. Increased vegetative cover provides a protective covering of streambanks, reduces lateral recession, traps sediment, and reduces erosive energy of the stream.

The Antelope Creek streambank erosion load allocation is based on the assumption that natural background sediment production from streambanks equates to 80 percent streambank stability as described in Overton and others (1995), where stable banks are expressed as a percentage of the total estimated bank length. Natural streambank stability potential is generally 80 percent or greater for Rosgen (1996) A, B, and C channel types in the volcanic and sedimentary geology types that are present in the Antelope Creek drainage.

Based on the streambank inventory from Antelope Creek, the estimated existing sediment load from streambank erosion is 82 tons per mile per year and the existing streambank stability is 62 percent. The estimated sediment load from streambanks that are 80 percent stable is 14.3 tons per mile per year. A sediment load reduction of 67.7 tons per mile per year is anticipated if 80 percent or greater streambank stability is achieved. Procedures used to develop these estimates are described in Appendix C.

It is anticipated that by reducing the chronic sediment load by 83 percent through increased streambank stability, the instream target of 28 percent subsurface fines will be achieved. If the instream target is attained, the beneficial use of natural spawning by Yellowstone cutthroat trout should eventually be restored to full support. Streambank stability, the percentage of subsurface fines, and age class structure of Yellowstone cutthroat trout must be monitored to determine the effectiveness of land management activities and of this TMDL.

BEAR CREEK SEDIMENT TMDL

Load Capacities and Targets

The sediment load that can be assimilated by Bear Creek and still meet the State's water quality narrative sediment criteria is unknown. The designated beneficial uses for Bear Creek are cold water biota and salmonid spawning. These beneficial uses are impacted by sediment loading above the assimilative capacity of the creek. The loading capacity lies somewhere between the current loading level and the sediment loading from natural streambank erosion levels. Cold water biota and salmonid spawning are naturally occurring beneficial uses in Bear Creek (note Table 7). We therefore assume that cold water biota and salmonid spawning would be fully supported at natural background sediment loading rates. We also assume that natural streambank stability was equal to or greater than 80 percent (Overton et al. 1995). When beneficial uses are met, the levels of streambank stability and depth fines will be used as benchmarks for use support through out the Palisades HUC.

The goal of this TMDL is to improve the quality of spawning and incubation substrate and rearing habitat for Yellowstone cutthroat trout in Bear Creek. The strategy in this TMDL will be to establish a declining trend in sediment loading, and to regularly monitor the sediment load and beneficial use support. The sediment target for this TMDL will be the percentage of subsurface fine (less than 0.25 inches diameter) sediment. The percentage of subsurface fine sediment is determined using a modified McNeil (McNeil and Ahnell 1964) sediment sampling technique. This technique is described in Appendix C. One site was sampled for sediment on Bear Creek in fall 2000 (**see results page C-13**). The site, located on Forest Service land, had a mean 33 percent subsurface fine sediment.

Other parameters for subsurface fines can affect salmonid production. Chapman (1988) suggested that fine sediment less than 0.03 inches in diameter is most responsible for suffocation and abrasion of salmonid eggs. Tappel and Bjornn (1983) report that sediment less than 0.37 inches in diameter can create a survival barrier preventing salmonid fry emergence from the redd. Hall (1986) found survival (eyed-egg to emergence) of coho, chinook, and chum salmon to be only 7 to 10 percent in gravel mixtures made up of 10 percent fines as compared to 50 to 75 percent survival in gravel mixtures with no fines less than 0.03 inches. Reiser and White (1988) observed little survival of steelhead and chinook salmon eggs beyond 10 to 20 percent fines less than 0.03 inches. These sediment particle size parameters should be considered as part of target monitoring to evaluate any significant shift in subsurface fine particle frequency distribution.

The subsurface fine sediment target for Bear Creek is less than or equal to 28 percent fine (0.25 inches) sediment, not including sediment particles larger than 2.5 inches, in areas suitable for salmonid spawning. It is also anticipated that the amount of habitat suitable for salmonid spawning will increase after implementation of management practices identified to reduce subsurface fine sediment. Subsurface fine sediment and salmonid age class structure will be monitored bi-annually beginning at completion of the initial implementation phase. By the completion of the third monitoring period, if the percentage of subsurface fine sediment is not decreasing, additional management practices will be applied to attain the target.

Load Allocation

The sediment load allocation for Bear Creek is developed from a streambank erosion inventory conducted by the IDEQ in October 2000. The inventory confirms earlier reports listed in the sub-watershed descriptions and shows that the primary source of sediment is from streambank erosion. A pack trail crosses the stream at least 11 times from the trailhead at Bear Creek campground to the confluence with North Fork Bear Creek. The trail shows additional erosion in some steeper locations adjacent to Bear Creek. The pack trail and campground see heavy recreational use. Streambanks within the majority of the listed segment of Bear Creek were found to be 32 percent erosive. Reduction of streambank erosion is directly linked to the improvement of riparian vegetation density and structure as well as maintenance of the stream crossings. Increased vegetative cover provides a protective covering of streambanks, reduces lateral recession, traps sediment, and reduces erosive energy of the stream.

The Bear Creek streambank erosion load allocation is based on the assumption that natural background sediment production from streambanks equates to 80 percent streambank stability as described in Overton and others (1995), where stable banks are expressed as a percentage of the total estimated bank length. Natural streambank stability potential is generally 80 percent or greater for Rosgen (1996) A, B, and C channel types in the volcanic and sedimentary geology types that are present in the Bear Creek drainage.

Based on the streambank inventory from Bear Creek, the estimated total existing sediment load from streambank erosion for the majority of the listed segment is 790 tons per mile per year and the existing streambank stability is 68 percent. The estimated sediment load from streambanks that are 80 percent stable is 65.7 tons per mile per year. A sediment load reduction of 724.3 tons per mile per year is anticipated if 80 percent or greater streambank stability is achieved. Procedures used to develop these estimates are described in Appendix C.

It is anticipated that by reducing the chronic sediment load by 92 percent through increased streambank stability, the instream target of 28 percent subsurface fines will be achieved. If the instream target is attained, the beneficial use of natural spawning by Yellowstone cutthroat trout should eventually be restored to full support. Streambank stability, the percentage of subsurface fines, and age class structure of Yellowstone cutthroat trout must be monitored at least annually to determine the effectiveness of land management activities and of this TMDL.

MARGIN OF SAFETY

In general, a TMDL is the sum of the individual wasteload allocations for point sources and load allocations for nonpoint sources and natural background (40 CFR 130.2) with a margin of safety (Clean Water Act section 303(d)(1)(c)). With no point sources in these two watersheds, the sediment TMDL for Antelope and Bear Creeks is the sum of the nonpoint source load allocation (including natural background) and the margin of safety. The margin of safety accounts for uncertainty in the relationship between the sediment load and the quality of the receiving waters. For Antelope and Bear Creeks, a margin of safety is provided implicitly through the analytical assumptions made in setting the 80 percent streambank stability target and in setting the 28 percent depth fines stream substrate target. Both of these targets represent conditions found in Idaho wilderness areas. The depth fine sediment target is based on primary literature values and permits an adequate level of survival during egg incubation and alevin “swimup” to provide for self-sustaining Yellowstone cutthroat trout production.

TEMPORAL EROSION VARIABILITY

Seasonal variation in sediment delivery due to sporadic precipitation and variable runoff hydrology must be accounted for in a TMDL. In the Antelope and Bear Creek load allocations, we have estimated sediment loads using average annual rates. These rates were derived from physical conditions that developed over a long time period under the influence of peak and base flow conditions. It is difficult to account for seasonal and annual variation within a given season, year, or period of years. However, the seasonal and annual variation is accounted for over the longer time frame under which the observed conditions in Antelope and Bear Creeks have developed. Annual erosion and sediment delivery rates are largely dependent on climatic factors where wet water years typically produce the highest sediment loads. The highest rates of erosion typically occur during spring runoff and summer thunderstorms. Since our sediment analysis uses long-term averages, it accounts for streambank recession during high runoff when the soils are saturated.

PUBLIC PARTICIPATION

Comments and Responses

Comments received from the United States Forest Service, Caribou-Targhee National Forest with responses in italics:

Page 1 Is the stream mileage presented in paragraph one ground-truthed or from GIS?

All of the stream mileage and other statistics in paragraph one are GIS data calculated from 100,000 scale stream segment hydrography and 250,000 scale 4th field HUCs from 1996 USGS data.

Page 3 Table 1: It is important to note that July and August are the months with the highest maximum temperatures. This is when water temperature monitoring should occur; especially in 303(d) listed streams.

A phrase was added to the text to highlight this climatological fact.

Page 4 The first paragraph says "A large proportion of the drainage basin is mountainous and forested, and the runoff pattern is ruled by the timing by (sic) snowmelt". Then the fourth paragraph says, "management of Palisades Reservoir currently regulates the water levels and volume of the South Fork Snake River". Finally the last paragraph says, "Tributary flows are not regulated. The mountainous character of most of the drainage contributes to the natural stream discharge. The runoff pattern is dominated by snowmelt,. . ." These sections should be clarified so the reader know the first and third references are related to tributary flows while the middle is related to main-stem flows.

In the first reference, the largest proportion of the drainage basin is the contribution of the tributaries, so the runoff pattern is from the tributary flows. The second reference refers to the main-stem flows since the sentence is about ". . .the water levels and volume of the South Fork Snake River". The third reference quotes "Tributary flows. . ." It is more redundant in discussing tributary flows again, but this paragraph was intended to go into more detail than the first introductory paragraph about tributary flows.

Page 4 Hydrology Section: A map would clarify where the different sections and the relative lengths of these sections are.

Figures 2 and 3 depict the hydrology of Palisades subbasin. Figure 2 delineates the location of the USGS real time stations that are referenced in Table 3 for stream flow statistics. Figure 3 illustrates the general drainage patterns. Scale is provided to show the relative length of the stream sections.

Page 4 Paragraph four: Is Palisades Reservoir managed for fish?

The 1990 draft Snake River activity/operations plan (BLM and TNF 1990) indicates management of Palisades Reservoir primarily for irrigation, but also for flood control, power generation, recreation and wildlife conservation. It is assumed that recreation and wildlife conservation include fish management.

Page 4 Paragraph four: If an analysis of average annual stream flow will not indicate natural hydrologic trends for the South Fork, why is this information presented in Table 3?

The flow of the South Fork is altered due to the construction and operation of Palisades Dam.

The USGS real time stations near Irwin and Heise are both downstream of Palisades Dam. Therefore, the average annual stream flow reported by these two USGS hydrological stations report altered stream flow rather than natural stream flow. The altered stream flow is reported because it is the most significant impact on the riparian habitat downstream of Palisades Dam.

Page 5 Paragraph one: Merigliano's comparative hydrographs would be more useful than Table 3. It would indicate changes to the natural system which could than (sic) be used to evaluate sediment transport, temperature trends, etc. . .

An image scanned from figure 4 of page 4 of Merigliano's document follows. These composite hydrographs contain the information that is narratively summarized in the text of the subbasin assessment.

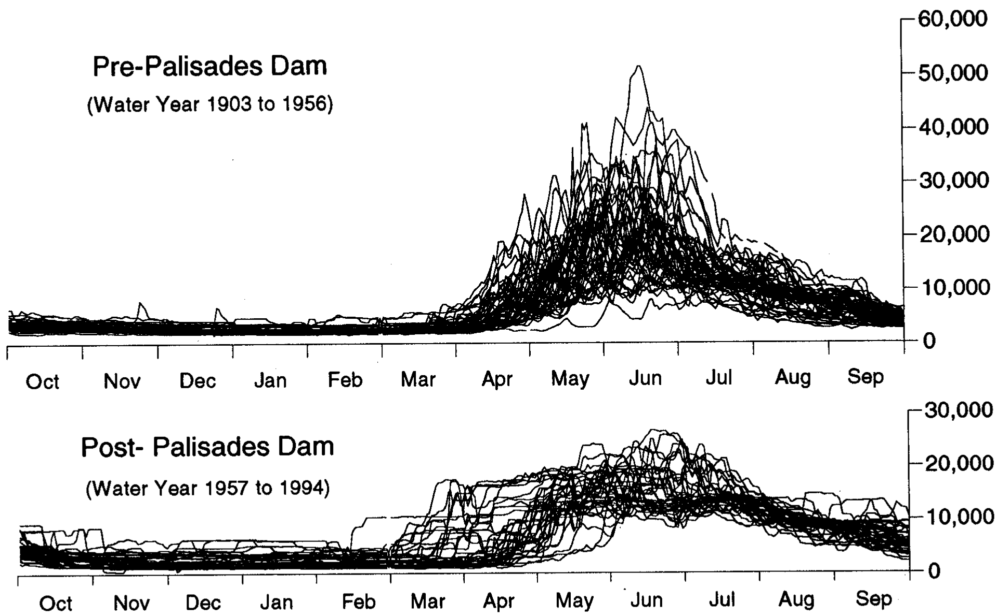

Figure 4. Composite hydrographs for the pre- and post-Palisades Dam periods, South Fork Snake River near Heise, Idaho. The pre-dam graph includes flows measured at the Lyon gaging station, which is comparable to the Heise station and was operated from 1903 to 1910. Flows during 1903 to 1906 and 1910 are unregulated. Units are cubic feet per second (cfs), and values are mean daily discharge.

Page 5 Paragraph one: Says "low flow conditions have been maintained during fall and winter months while the reservoir is filling". Are these flows lower than natural? Given this years (sic) debate on flow releases, I'd guess they are reduced. The next sentence says, "generally, Palisades Reservoir management keeps the river at bankfull condition". When? For how long? It than (sic) says "moderate flows are the most efficient at transporting sediments over time. . ." Research has shown that flows in the neighborhood of .8 Bankfull on the rising limb of the hydrograph are the most efficient flows. What is happening to these flows? Frequency? Duration?

All of Page 5, Paragraph one is a narrative summary of the information graphically depicted in Merigliano's composite hydrographs comparing pre- and post-dam years: "After the (Palisades) dam began controlling water discharge in 1957, three significant flow alteration trends appear on the comparative hydrographs." The low-flow conditions maintained during the fall and winter months by reservoir management are lower flow than natural conditions in order to enable the reservoir to fill. Merigliano's research summarized as "moderate flows are the most efficient at transporting sediments over time. . ." was research specific to the Palisades subbasin *watershed. As referenced again the Geology and Geomorphology section on Page 10, the sediments that Merigliano's study found to be transported as sediments in the South Fork are rounded cobble from the glacial deposits, with more angular gravel in the tributaries. The glacial deposit sediments are those that he found to be transported most efficiently by moderate flows. He found these moderate flows to be similar in frequency for pre- and post-dam data, but altered at timing. More of these moderate flows can be found "Throughout the summer months. . ." when ". . .larger peak flows that could lead to flooding are reduced and controlled."*

Some of the wording in this paragraph was altered according to suggestions by the Idaho Department of Fish and Game. The sentence "[g]enerally, Palisades Reservoir management keeps the river at bankfull condition" has been struck from the final document.

Page 5 Table 3: Is the minor decrease in "lowest annual" flows due to irrigation? There are many tributaries coming into this reach. What do you attribute the loss of water during low flows? Can this table be split into pre and post dam? Mixing these periods can distort what is truly happening. The Merigliano reference presented earlier would be more useful. Sediment impacts may not be source related, it could be that the system is no longer efficiently processing sediment due to altered flows.

A sentence has been added to the text to surmise that if Palisades Reservoir is managed primarily for irrigation needs, then the minor decrease in the lowest annual streamflows at the downstream Heise gage may be due to irrigation withdrawals.

At the time IDEQ accessed the data on the USGS surface water data at http://idaho.usgs.gov *website, the data could not be manipulated in such a way to provide statistics for pre- and post-dam average annual, highest annual or lowest annual streamflow. Subsequently, the figure showing pre- and post-dam streamflows has been scanned and inserted into this discussion.*

Pages 6-7 Add streams to GIS layers.

The streams are depicted on these figures. IDEQ will make a better effort to clarify the reproduction of the graphics in the final subbasin assessment and TMDL.

Page 8 Add open water to GIS layer.

Open water is depicted as a white, or transparent, pattern on Figure 4. Please note line number nine on the legend for the reference to open water.

Geology Section. What is the mineralogy of the various parent materials? Do they break down into clay/silt or sand/fine gravel particles? This would affect how sediment is transported through the system. Clay and silt influence turbidity; Sand and Gravel influence bedload and subsurface sediment levels. The importance is that if a subbasin were producing sands, it would make more sense to monitor surface and subsurface sediments than turbidity.

Additional information has been added to this section. The Tetonia-Rin-Ririe soils found on loess foothills and mountainsides are silt loams. The Hobacker-Badgerton soils found on flood plains are gravelly loams and sandy loams.

Vegetation Section What about tributary riparian areas? This is important for temperature, large woody debris, and channel stability. A map of riparian area size/age classes would also be useful. If we are going to use bank stability as the TMDL, we should know the contribution of LWD in maintaining channel stability (this is very important in certain stream types).

Information on riparian areas has been inserted in the vegetation section and in the sub-watershed descriptions. Riparian vegetation was included based on IDEQ Beneficial Use Reconnaissance Project field notes that described dominant vegetation at the sample sites. Information on the physical habitat was also included from the TNF 2000 cutthroat trout distribution survey reports.

Tables 4-6: Again what about riparian areas.

Information on riparian areas has been inserted in the vegetation section and in the sub-watershed descriptions.

Fisheries Section Table seven: The Caribou-Targhee has additional information from 2000 sampling.

Additional information from the TNF 2000 cutthroat trout distribution survey reports has been included.

Page 19 Land Ownership: The Caribou-Targhee is one forest.

The text has been altered in this section to show that historically Targhee National Forest has managed forests north of the river and Caribou National Forest has managed forests south of the river. During the year 2000, these forests have combined into the Caribou-Targhee National Forest. The literature referenced in this subbasin assessment and TMDL is specific to information that was authored either by the Targhee National Forest or by the Caribou National Forest. No information authored by the combined forest has been referenced in this document.

Page 23: Watershed Descriptions

- Does the 878,144 acres include the entire Palisades Subbasin or just the Idaho portion?

The Palisades subbasin covers approximately 537,407.6 acres or 839.7 square miles in Idaho. The first sentence in this section had been incorrect, and is now corrected to the true area. This GIS data was calculated from 1996 USGS data.

- Do either the BOR or YMCA facilities have fish passage?

A sentence has been added regarding fish passage around Palisades Dam, to-wit: "[p]alisades Dam has a fish screen that has been constructed on Palisades Creek, which joins the Snake River approximately 3 miles downstream from the dam". For the small Big Elk Creek Powerplant, "[f]ish passage is insured via a minimum 25 percent streamflow". The dam is actually located on a small tributary to Big Elk Creek, so fish passage is guaranteed on the small tributary as well as Big Elk Creek.

- The FS has detailed data (2000) on Pine and Burns (and tribs).

Information has been added to the sub-watershed descriptions from the TNF 2000 cutthroat trout distribution survey reports.

- Throughout this section the stream mileage seems high. Therefore, I assume it is from GIS and is not field verified:

All of the sub-watershed descriptions report stream mileage from GIS calculations. The data source for the 5th field HUCs is Idaho Department of Water Resources 1:24,000 from 1994-1997. The data source for streams is Idaho Department of Water Resources 1:100,000 from 1994-1996. IDEQ has subsequently included this reference in the watershed descriptions.

During the assessment phase of the Palisades subbasin assessment, IDEQ crews scrutinized the drainages of each of the 303(d)-listed streams, with the exception of Camp Creek. Certain sections of the 303(d)-listed streams were ground-truthed.

Page 23: Antelope Creek

- We should identify that this is a composite watershed rather than a true watershed. That is, effects in Burns and Antelope Creek will not produce cumulative effects in Antelope. From a watershed prospective (sic) there is a huge difference between a true and a composite watershed.

A phrase has been added to indicate that Antelope Creek is a composite watershed.

- The second paragraph says that invertebrate habitat have been degraded by high levels of cobble embeddedness from fine sediment. Where is this sediment coming from? Bank erosion? Roads? ATVs? Etc. . .

A sentence was added to this section to indicate that concerns over agricultural impacts to water quality were the impetus for the 1989 study by the East Side Soil and Water Conservation District. Best management practices have subsequently controlled sediment delivery from agricultural lands.

Grazing and roads are suggested as current sources.

- What size sediments does the local geology produce? Should we be looking at turbidity (produces clay and silt) or bed materials (sand and fine gravels)? With a high level of cobble embeddedness, I'd guess the basin produces sand/fine gravel.

The 1981 SCS soil survey indicates that the drainage of Antelope Creek is part of the Tetonia-Rin-Ririe soil series with deep silt loams, which are highly erodible depending upon slope. This information is reported in the geology section.

Blew 2000 indicates that the substrate is dominated by fine-grained sediment.

Page 25 Bear Creek Paragraph 1:

- This section says the upper reaches are a large Beaver complex or a Rosgen F type. Is this correct? Beaver complexes usually don't fit F channel types since they are deep and F channels have high width:depth ratios.

Idaho DEQ 1996 beneficial use reconnaissance project data is the source of the designation of the upper reaches of Bear Creek as a Rosgen F channel type. Personal observations of IDEQ personnel in October 2000 confirm that the entire upper reaches of Bear Creek are a beaver complex. The reconnaissance looks at a single 100-meter transect for each site, so the channel type can be different above and below the site. It has been confirmed by TNF 2000 cutthroat trout distribution survey reports that the upper reaches of Bear Creek are a beaver complex.

- This section also says, "in addition, many sharp meanders have deeply undercut the banks causing slumping and mass wasting." Deeply undercut banks provide good habitat in "E" channels. Is this supposed to be an E? As written it says the sharp meanders caused the mass wasting. Did the sharp meanders cause the undercuts and another disturbance such as cattle cause the banks to fail? If overhangs are well vegetated (with deep rooted plants—sedges or willow) they can be very stable.

During IDEQ's assessment of the status of beneficial use support in Bear Creek, a lack of stabilizing vegetation adjacent to the stream was observed. The stream appears to have incised over time.

- It appears that Bear Creek is laterally unstable which is common in heavily grazed meandering streams. This is consistent with a high degree of bank and riparian disturbances (evidence=F channel type, mass wasting banks, braided channel).
- I'd assume the headcutting is associated with the channel cutting through sediments deposited as a result of the lateral instability. This could result in the formation of a "channel within a channel" whereby the floodplain is converted into a terrace. This is a common evolutionary pathway.
- This first paragraph says, "At roughly mid reach there is riparian degradation on both banks." It also says, "There is some riparian degradation in the lower reaches." From what?

In response to the last four points, IDEQ personnel investigated Bear Creek in October 2000. The sharp meanders causing undercut are mainly not on stable, well-vegetated overhangs. There is some lateral instability. Evidently there had been a previous blow-out event, indicated by a wooden stream-crossing that had been apparently removed and deposited further downstream by high waters. Apparently, the current bank and riparian disturbances occur from the heavy recreational use of a pack trail. The trail fords the stream at least eleven times from the Bear Creek campground trailhead to the confluence of North Fork Bear Creek. Historical disturbances from overgrazing were also evident. The apparent overgrazing seemed to be decades old, and the riparian vegetation appeared to be revegetating fairly well on its own. It seems that currently, most of the meanders are on a depositional floodplain. However, the sharp meanders causing undercutting indicate that there is still an impact to the riparian zone. The only apparent impacts are the heavy recreational use.

Page 25 Bear Creek Paragraph 2:

- This paragraph says, "This instability is evidenced by a degrading streambed. . ." Is this a true degrading streambed (as with channelization) or is the channel cutting through previously deposited sediments resulting from Beavers or bank erosion? With all the references to aggradation, I'd suspect the channel is attempting to route previously deposited material as opposed to scouring into the older streambed. This is commonly observed when a Beaver Dam washes out.
- The beaver dams are trapping sediment. . .
- The FS constructed a new trail away from the creek to reduce impacts. However, use still continues on the lower trail.

In continuation of the previous response, the heavy recreational use of the lower pack trail on Bear Creek seems to be causing the current contributions to sediment loading.

Page 25: Big Elk Creek. Again, describe whether this is a true or composite watershed.

A phrase has been added to indicate that Big Elk Creek is a composite watershed.

Page 26: Big Elk Creek

- Says, "Pool development in this area improves along with an increase in the distance between pools and riffles." Does this mean there are larger, higher quality pools; but the riffle between them is longer? Or does it mean there are now pools (while they were rare in the upper area) but the area is still mostly riffle?

TNF stream inventories indicate that pool development is improved in the lower reaches of Big Elk Creek. The sentence was altered for clarity.

- For Little Elk Creek it says there is riparian degradation in the lower reaches. From what?

Riparian degradation has occurred from grazing. This phrase was added to the subbasin assessment.

Page 26: Fall Creek

- Is this a true watershed?

A phrase has been added to indicate that Fall Creek is a true watershed.

- Are banks stable?

No. 1996 IDEQ reconnaissance data shows 42% mean stability.

- Is the fine textured streambed natural or are sediments overlying a gravel/cobble bed?
- Is the abundance of fine sediment the result of increased sediment production or has the routing of naturally produced sediments been slowed down due to Beaver?

Low bank stability suggests increased production. Upper Fall Creek contains old and new beaver dams that may contribute to reduced routing of fine sediments.

Page 27: Indian Creek

- Does the acreage include the entire watershed or just Idaho?

Only the Idaho portion of Palisades subbasin, including the Indian Creek sub-watershed, is addressed in this subbasin assessment.

- Is it a true watershed?

A phrase has been added to indicate that Indian Creek is a composite watershed.

- This section says that the banks and channel have high rock contents. This generally means the channel is resilient and can resist impacts. However, it also says it is small so it's susceptible to riparian degradation. It also implies that this is the cause of a great deal of sediment that has been delivered to the channel. Is this the intent of these statements or is the sediment coming from somewhere else? My understanding is that the sediment is likely coming from natural instability and mass wasting in the upper basin. Is this true? It's clear that sediment is causing aggradation and braiding, the question is where is it coming from?

The 1980 stream inventory conducted by Palisades Ranger District indicated that the high rock content was composed of small-sized rocks, making the streambanks more vulnerable to trampling by cattle. This section has been revised for clarity. The source of the sediment at this time was apparently from grazing. A more recent source is landslides (TNF 1999).

- In addition, what roll (sic) is beaver playing in the routing of sediment? Are they making naturally produced sediment appear to be a volume problem or is routing the issue?

Beaver dams are slowing the routing of sediment, making naturally produced sediment appear to be a volume problem.

- Are the problems with grazing and recreational vehicles just in the Burns Creek drainage or Indian Creek wide? Is it really livestock or wildlife (you say there is no allotment)?

Reports available to IDEQ indicate only the Burns Creek drainage is effected by grazing and recreational vehicles. Burns Creek would be located in the Trout Creek grazing allotment, and at this time, there is no grazing rotation scheduled for this allotment.

Page 27: McCoy Creek. Is this a composite or true watershed?

A phrase has been added to indicate that McCoy Creek is a true watershed.

Page 27: Palisades Creek. I wouldn't call the channel "very stable". A lot of the bedload (likely natural from landslides) is still very mobile as illustrated by a lack of vegetation on many bars.

Reports available to IDEQ indicated good streambank stability in the locations that were surveyed during IDEQ reconnaissance and TNF surveys. Since these surveys were in specific sites and not along the entire stream, the stability statement has been removed.

Page 28: Pine Creek
- We have a 2000 survey on Pine, NF Pine and WF Pine.

This information was received November 20, 2000.

- There is a high degree of bank instability in the flatter meadow reach between the Pine Creek lodge and the North Fork. This area also has a high level of fine sediment. Our surveys may clarify conditions in this area.

Text has been added from TNF 1999.

- The FS monitored water temperature in the canyon and in the meadow and both exceeded state temperature standards.

Upper Pine: Max = 24.6 degrees C, # days over standard = 33 (below WF Pine Cr.)
Lower Pine: Max = 23.1 degrees C, # days over standard = 14 (@ Forest Boundary)

IDEQ would like to request the raw data from these surveys. Upon receipt of this data, IDEQ would be able to consider Pine Creek for the 2002 303(d) listing process. Currently, Pine Creek is not listed on the 1998 303(d) schedule. Under Idaho's current 8-year judicial schedule for TMDL development, only those waterbodies currently scheduled on the 303(d) list can be addressed in this subbasin assessment and TMDL.

- Page 28 and 29: Rainey Creek
- Is this a true or composite watershed?

A phrase has been added to indicate that Rainey Creek is a composite watershed.

- Why is there an F channel type? This is usually a sign of lateral instability.

A Rosgen F channel type was reported at a sample site at elevation 5270 feet by an IDEQ beneficial use reconnaissance project crew (see Appendix A). These sites represent an exploratory investigation rather than a comprehensive survey. The text has been altered to indicate the B channel type reported in TNF 1999.

- What altered the sinuosity of Squaw Creek? Channelization?

There is a roadway adjacent to the stream in the lower reaches of Squaw Creek. A phrase was added to the text to indicate this fact. According to field notes during the 1996 beneficial use reconnaissance survey, the right bank of the lower 30 meters of the reach appeared to have been recently buried by material from the road.

Page 29: Swan Valley

- Is this a true or composite watershed?

A phrase has been added to indicate that Swan Valley is a composite watershed.

- The FS had a controlled burn get away here in 1999. Several locations in Garden Creek burned hot and a long section of riparian area was burned over. Riparian structure, bank stability, and fine sediment levels will be affected for several years. A 2000 review found approximately 50% of the banks were unstable in the burn area.

Information has been added to the Swan Valley sub-watershed descriptions regarding the Garden Creek/Pritchard Creek burn. Unpublished information was received from the Palisades Ranger District that described the prescribed fire chronology of events.

IDEQ requests any additional information the Forest Service has collected in 2000 regarding stability of the streambanks for consideration during development of the 2002 303(d) list.

OVERALL: Did you find any streams/reaches that could be used as reference reaches? These area could then be used for comparisons against more disturbed areas to determine natural versus anthropogenic effects.

IDEQ did not observe a reference during the reconnaissance survey or the subbasin assessment and TMDL development.

Page 29: WQL. However, the FS found Pine Creek exceeds state temperature standards.

IDEQ will request the raw data and will consider it during the 2002 303(d) listing process. Currently, Pine Creek is not listed on the 1998 303(d) schedule. Under Idaho's current 8-year judicial schedule for TMDL development, priority is given to streams listed in the original settlement. As such, only those waterbodies currently scheduled on the 1998 303(d) list will be addressed in this subbasin assessment and TMDL.

Page 31. However, flow alterations must be addressed in dealing with sediment and temperatures. Sediment impairments may be the result of a loss in sediment transport capacity not just additional sediment. Temperatures can rise faster if there is less water to heat. Therefore, in water bodies affected by flow alterations and sediment or temperature, I don't know how we can ignore flows.

IDEQ has no legislative authority to recommend or mandate flow-related management. Water quantity is exclusively managed by the Idaho Department of Water Resources. Flow alteration policies are stated in the WATER QUALITY STANDARDS AND WASTEWATER TREATMENT REQUIREMENTS (IDAPA 58.01.02), which were approved by the Idaho legislature:

050. ADMINISTRATIVE POLICY.

01. Apportionment of Water. *The adoption of water quality standards and the enforcement of such standards is not intended to conflict with the apportionment of water to the state through any of the interstate compacts or court decrees, or to interfere with the rights of Idaho appropriators, either now or in the future, in the utilization of the water appropriations which have been granted to them under the statutory procedure, or to interfere with water quality criteria established by mutual agreement of the participants in interstate water pollution control* *enforcement procedures.*

Page 34. There should be a new heading for the paragraph starting "water quality criteria. . ."

Text was altered according to recommendation.

Page 36. I'm not sure what the last sentence means. If there is no data, how can DEQ know there is an exceedance of numeric criteria?

The word "exceedances" has been struck from the text.

Page 37. It would be helpful to see the USGS temperature data in Celsius as well.

For consistency throughout the report, everything has been reported in English units. For convenience, Centigrade units have been added in parentheses after each Fahrenheit measurement in this section reporting USGS data.

Page 38. The FS now has temperature data for Pine Creek. This data is summarized above.

IDEQ will request the raw data and will consider it during the 2002 303(d) listing process. Currently, Pine Creek is not listed on the 1998 303(d) schedule. Under Idaho's current 8-year judicial schedule for TMDL development, priority is given to streams listed in the original settlement. As such, only those waterbodies currently scheduled on the 1998 303(d) list will be addressed in this subbasin assessment and TMDL.

Page 39. The second paragraph under "Upper Snake River Basin Status Reports" says that in 1991 it was too early to report the findings of a BLM study. How about now?

This section summarizes waterbody assessments reported in the Upper Snake River basin status reports for 1989, 1991 and 1994. Results of BLM monitoring for upland erosion and fish population in 1991 have not been found at this time, so the sentence has been struck from the text.

Page 40: Antelope Creek. There are also USFS lands in the headwaters.

Although IDEQ is extending the listing of Antelope Creek onto Forest Service land, at this time the 1998 303(d) list is the current list of impaired waterbodies. The 1998 303(d) list includes Antelope Creek from the State land boundary to South Fork Snake River. The discussion of Antelope Creek on Page 40 is restricted to the drainage of the listed section of Antelope Creek.

Page 43: Add Pine Creek for temperature?

IDEQ will request the raw data and will consider it during the 2002 303(d) listing process. Currently, Pine Creek is not listed on the 1998 303(d) schedule. Under Idaho's current 8-year judicial schedule for TMDL development, priority is given to streams listed in the original settlement. As such, only those waterbodies currently scheduled on the 1998 303(d) list will be *addressed in this subbasin assessment and TMDL*

Page 44: Fall Creek. The last sentence can be confusing. Instead of saying “leading to 303(d) listing. . .” saying “which could lead to a 303(d) listing” would be clearer.

Text was modified for clarity.

Page 46-47: Load Capacity and Targets

- How do these studies apply to this specific area? Bjornn’s work was dealing with fish that evolved in the batholith.

The cited studies provide a technical foundation to support the commonly used Forest Service sediment targets.

- On page 47 it talks of monitoring, by whom?

The details of the implementation plan needed to meet the prescriptions in the TMDLs will be drafted within 18 months of TMDL approval by EPA. The implementation plan will identify the parties responsible.

Page 47: Load Allocations

- If the streams can assimilate sediment when bank stability is at 80%, then a target of 80% would only remove “new sediment” and not that already in the system (and we would continue adding sediment until the 80% is reached). To clean out the stream, we would need to reach maybe 85%. At this rate the streams could assimilate the annual sediment produced by the 20% eroding banks (80% stable) and remove accumulated sediment with the additional reduction in “new sediment” (produced with the additional stability). Once the stream fully supports beneficial uses, or meets the % fines target, the bank stability threshold could fall back to 80%. This also accounts for the required margin of safety.

80% bank stability is anticipated to sufficiently reduce sediment production and lead to full support of beneficial uses. Implementation of an 85% bank stability target would further reduce sediment production leading to quicker beneficial use restoration. The Forest Service is encouraged to implement the 85% bank stability target if their resources allow.

- What does this mean with regard to land management?
- I would recommend mandating a “no net increase in disturbed banks or sediment production” policy or specific BMPs until we reach this point. For example, if an activity increased sediment production in one part of a watershed is should reduce it somewhere else (road obliterations, fencing, etc. . .). Otherwise, I’m not sure we’ll actually head in the right direction. I think we need a road map on “how to get there from here”.
- How would an activity be evaluated for consistency? If a stream is listed for sediment and there is cattle grazing in an area with 70% bank stability, can that cow go to water and trample a bank or must the entire stream be fenced until it reaches 80%? Does the 80% target apply at the reach scale, the stream scale, the sub-watershed scale, or the watershed scale? Does the “TMDL” target prioritize the most unstable reaches?

The 80% target applies at the reach scale. Implementation of the TMDL should target the most unstable reaches (i.e. the most sediment producing).

- As written, this methodology is dangerous because all activities that affect banks could be closed down if the stream is not meeting its target. I'd assume the intent is producing improving trends. For example, can we say that current land use led to a bank stability level of 70%; and that since our proposal would reduce overall bank impacts, we would be heading in the right direction and we're ok (this may involve livestock reductions, fencing, etc. . .)? This would be consistent with the no net increase concept as this is a reduction in impacts (annual bank impacts/sediment). It's clear that some changes are needed since existing practices aren't protecting the banks.
- Again, providing targets without direction (on how to get there or who is responsible) may not get use where we need to be. How can we ensure we'll reach our targets? How will we increase streambank stability? Will DEQ require specific actions along specific reaches?
- I can see an environmental group suing us for producing any sediment in drainages with bank stability less than 80%. Even one hoof print. . .
- Who will be doing the monitoring? Specifically where would it be? What techniques—visual, measured transects, representative reaches?

DEQ relies on fellow Designated Management Agencies (DMAs) for implementation of TMDLs to restore beneficial uses in impaired water bodies they manage. In the case of the US Forest Service, the forest has, "the statutory authority to permit and regulate land use activities. . .which may affect water quality. As a DMA, the Caribou-Targhee National Forest is responsible for implementing nonpoint source pollution control for land use activities. . ." (Dailey et al. 1999). The Caribou-Targhee National Forest may use a "no net increase" policy to implement a TMDL.

The details of the implementation plan needed to meet the prescriptions in the TMDLs will be drafted within 18 months of TMDL approval by EPA. The implementation plan will identify the parties responsible.

Pages 48-49: Bear Creek

- Same comments as for Antelope Creek.
- A new section of trail was constructed above Bear Creek to reduce impacts.

Same response as for Antelope Creek.

Page 49: Margin of safety. As noted above while 80% may represent natural, it may not remove the excess sediment produced during times when erosion exceeded natural for a number of years. A target of 85% could provide a margin of safety until the fine sediment target is met.

80% bank stability is anticipated to sufficiently reduce sediment production and lead to full support of beneficial uses. Implementation of an 85% bank stability target would further reduce sediment production leading to quicker beneficial use restoration. The Forest Service is encouraged to implement the 85% bank stability target if their resources allow.

Appendix A. Several stream types appear to be questionable.

- Lower Antelope has a very low w/d for an “F” channel type (4.3). In my experiences most “F” are 20+.
- Mid. Bear Creek has a very low w/d for an “F” channel type (8.5). In my experiences most “F” are 20+.
- Low Bear Creek has a very wide w/d for a “B” channel type (32.3). In my experiences most “B” fall within 12-20
- Fall Creek has low w/d values for “C” channels, they may be “E”?
- Indian Creek has a w/d of 65.4 Normal range of “B” channels is 12-20. This may be a “F” or if braided a “D”.
- Upper Pine has a very low w/d for a “C”; maybe it’s an “E”?

Width/depth ratios originally recorded were based on wetted width and wetted. These sites represent an exploratory investigation by the beneficial use reconnaissance crews rather than a comprehensive survey. The streams would need to be evaluated along the entire length of them in order to determine the appropriate Rosgen channel rating of the streams overall.

Appendix C. The first method for establishing later recession rates could be misleading in certain channel types. For example, a stable “E4/5” channel type could easily fall into a moderate rating when in fact it is slight. This is because Bank/Channel shape would score a 3, and bottom would get either a 1 or 2. However, the channel could be very stable and erosion could be slight. The second method would be much better for this particular stream type. In the data presented in Appendix A, no “E” channels were called but as I pointed out an “E” could be present.

During implementation of the TMDL, streambank treatments will be tailored to fit the existing situation and to achieve the stability target.

C-5: Site Selection

- This section says, “Stream bank erosion tends to increase as a function of watershed area.” This may be true with regard to stream energy and channel erosion resulting from scour. However, direct impacts associated with grazing impacts can occur wherever animals are concentrated. This could include the upper reaches as well as lower ones.

During implementation of the TMDL, streambank treatments will be tailored to fit the existing situation and to achieve the stability target.

- Will future monitoring be done on the same sites? If not, improvements/declines may be due to site differences and not true changes. Where are these sites? Maps?

IDEQ anticipates a subset of treatment sites will be selected and monumented for implementation and effectiveness monitoring. Site selection will occur during the implementation phase of the TMDL.

C-7: Site Selection. Again, the same sites must be sampled to ensure we are detecting change.

Also there should be a description of the site in order to interpret the data. For example, is a new piece of woody debris causing scour at the monitoring site? If so, is this the true cause of change? This would mean the change is locally driven and not the result of improvements in the watershed. Photos document these types of changes very well.

IDEQ anticipates a subset of treatment sites will be selected and monumented for implementation and effectiveness monitoring. Site selection will occur during the implementation phase of the TMDL.

C-9 – C-13. The forest would like copies of the data sheets and any detailed analysis that was completed on USFS lands. We could then incorporate this data into our analysis regarding future management. If possible, we would also like data downstream of the forest so we could use it to evaluate the cumulative effects of our actions.

Copies of IDEQ data sheets from the October 2000 streambank erosion inventories and McNeil sediment core sampling are being forwarded to the Caribou-Targhee National Forest hydrologist. Additionally, sampling in Palisades subbasin was performed in summer 2000 by a private contractor. The final report and a CD-ROM containing data is being forwarded to the hydrologist.

Comments received from the East Side Soil & Water Conservation District with responses in italics:

Page 5: The flows listed on table 3 show flows for one year, but over a 10-year period the high flows are much higher than those shown. Please include peak flows for period of record.

Table 3 is showing the entire period of record from 1935 through 1999 for the Irwin station and from 1911 through 1999 for the Heise station. Average annual, highest annual and lowest annual streamflow is given for general information. A scanned image of composite hydrographs has been added to this section for information on pre- and post-dam streamflow patterns.

Page 36: On the waterbody assessments list, the 2000 monitoring is not included.

After circulation of the draft, TNF forwarded fish assessment data via the 2000 cutthroat trout distribution survey reports. Information from these reports has been included. If there were any additional assessments accomplished in 2000, IDEQ would be happy to include this information.

Page 38: The USDA Forest Service has completed an extensive fish inventory on the tributaries to the South Fork of the Snake River in 1999-2000. Please include this data.

After circulation of the draft, TNF forwarded fish assessment data via the 2000 cutthroat trout distribution survey reports. Information from these reports has been included in Table 7.

Page 42: The East Side Soil & Water Conservation District's Water Quality Program for Agriculture—Granite Creek project includes more acres than what is directly adjoining Granite Creek. About half of these critical acres are under project contract with the goal of 75% to be reached by the end of 2001.

This section has been amended to include this additional information.

Page 46: Is the goal of 80% Streambank stability achievable on private ground and with Antelope Creek being a modified stream, since the study by Overton was for wilderness conditions and natural streams?

Information available to IDEQ indicates the privately owned land bordering Antelope Creek has finer-grained soils and tends to be flatter than the areas evaluated in Overton et al 1996. Given these conditions, the ground should support as much or more vegetative cover as the wilderness conditions.

Page 47: Is this discussion on Streambank stability referring to the upper portion of Antelope Creek?

Yes, the discussion is referring to the upper portion of Antelope Creek and extrapolated down to the private property.

Page 50: Again, same question as on page 46—Is the goal of 80% Streambank stability achievable on private ground and with Antelope Creek being a modified stream, since the study by Overton was for wilderness conditions and natural streams?

Information available to IDEQ indicates the privately owned land bordering Antelope Creek has finer-grained soils and tends to be flatter than the areas evaluated in Overton et al 1996. Given these conditions, the ground should support as much or more vegetative cover as the wilderness conditions.

Page B10-B14: Tables B1-B5 doesn't include any data on Antelope Creek. Could this data be included?

The report in Appendix B was produced to identify pollutants that were not known for the 1998 303(d) listing. Antelope Creek was listed for sediment. The data for Antelope Creek is available upon request.

Page C9-C10: There is not enough data to work through the direct volume method calculations which were used to figure the erosion (Tons/Mile/Year). Could this data include the worksheets that were used to calculate these totals? What was the Cumulative rating on Antelope and Bear Creeks—Slight, Moderate, Severe or Very severe?

The field notes used for these calculations will be forwarded to the East Side Soil & Water Conservation District. The spreadsheets found on these pages comprise the front side of a complex macro that is worked through an Excel spreadsheet, and IDEQ would be happy to forward the electronic version to the East Side Soil & Water Conservation District.

Additional comments received from the East Side Soil & Water Conservation District with responses in italics:

Page 5/paragraph #1: The authors state that "moderate flows are the most efficient at transporting sediments over time, and the frequency of moderate flows has not changed significantly with the operation of the dam". Please include the data collected or used in flood frequency analysis or return interval charts.

All of Page 5, Paragraph one is a narrative summary of the information graphically depicted in Merigliano's composite hydrographs comparing pre- and post-dam years.

Page 23/paragraph #1:

- The authors state the classification system that they chose but what level 1, 2, 3, or 4 did they complete on these subwatersheds and streams?

The sub-watershed descriptions are based upon fifth-field HUC scale.

- Did the authors base their observations on USGS 1:24K maps with ground-verification or BURP site data? Describe their methods better.

The sub-watershed descriptions are based upon GIS data from IDWR, field reconnaissance, TNF surveys and the other references cited in the text.

- Is the gradient reported based on stream or valley gradient? Some gradients with associated stream types vary significantly from guidelines found in Rosgen (1996).

The gradients reported are stream gradients.

Page 23/paragraph #2: The authors do an excellent job (perhaps the best of any TMDL I have reviewed so far of using geomorphic description for stream systems), however they did not classify or describe the Antelope subwatershed as they did with other subwatersheds. Any reason why this occurred?

Additional information on Antelope Creek was added from the TNF 2000 cutthroat trout distribution survey reports.

Page 23/last paragraph: Stream surveys were carried out on private land but the authors do not state by whom, when or where? No citation for this evidence?

Text has been modified to clarify that the private land surveys were reported by the East Side Soil and Water Conservation District in 1989.

Page 40/paragraph #3:

- Is the upper BURP site at full support? Needs verification? Not full support?

The upper BURP site is full support (refer to Appendix A site 1994SIDFA013).

- Streambank stability is 55-60% stable, why cite Overton et al. if local data could be used?

Streambank stability is not the parameter IDEQ will assess to evaluate beneficial use support. It is a target by which we hope to reduce fine sediment production. If the target is met and maintained, we anticipated improvement in the beneficial uses. Local data will be gathered and used to assess treatment implementation and effectiveness.

Page 41/paragraph #3:

- Was there any application for funding submitted for Rainey Creek implementation?

The SCS 1994 report indicated that the PL 566 proposal was never implemented. The authors are not aware of all of the reasons.

- "No support" refers to no local support or state funding support for the project?

State funding support was not obtained.

Page 43/paragraph #2: The authors state that due to flow alteration on the segment below the dam, there will be no sediment load allocation adopted. Is this consistent with other TMDLs in this region or state?

This is regionally consistent with the Lemhi TMDL, Little Lost TMDL and the Medicine Lodge TMDL (in process).

Page 45/paragraph #2: What data has been collected and presented to lead the authors to their conclusions about Little Elk Creek trending upward? And what “reasonable time period” would this occur in?

The conclusions are based on our observations that the channel has been scoured by natural hydrologic events and that no management issues were observed in the riparian area. These conditions will tend to improve naturally in a geologic timeframe.

Page 47/paragraph #4: Natural streambank stability is assumed to be 80% for Rosgen A, B, C channels, where do the authors find and present the evidence? Overton et al, PACFISH, BURP or other data?

The streambank stability target is taken from Overton et al 1995, as referenced in the discussion of sediment TMDL methods and results in Appendix C. Other pertinent references include NRCS 1983 and McNeil and Ahnell 1964.

Page 50/paragraph #2: The authors’ use of Rosgen’s classification system, which is highly dependent on bankfull determinations, seems to contradict their statement and use of average annual runoff for setting sediment load allocations in the Antelope and Bear Creek.

The sediment load allocations are not based on the Rosgen channel classification system, but are based on streambank stability measurements and NRCS recession rates.

Comments received from the Greater Yellowstone Coalition with responses in italics:

The applicable substance of a letter dated December 8, 2000 from the Greater Yellowstone Coalition is extracted as follows:

“GYC’s main concern involves flow alterations. The effects of flow alterations on fisheries, riparian vegetation, and other protected beneficial uses are considerable. The Draft states that “[a]lthough flow alterations can adversely affect beneficial uses, there are no Idaho water quality standards or criteria that addresses it,” and “EPA is in agreement with this position and has incorporated it into their new 303(d) rules” (draft p.31). Water quality and water quantity are inextricably linked. The impacts of pollution are relative to the amount of water flowing in a stream.

40CFR 131.12 (a) states “the State shall develop and adopt a statewide anti-degradation policy and identify the methods for implementing such a policy pursuant to this subpart. The anti-degradation policy and implementation method shall, at a minimum be consistent with the following:

(1) existing instream uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.”

Since flow alteration can degrade water quality, states are required by the Clean Water Act (CWA) to develop and implement plans to correct the problems associated with flow alteration. If states have no policy to deal with this issue, such as Idaho, then EPA is delegated authority. While EPA may recognize Idaho has not set standards or criteria for flow alteration, it appears to be a violation of the CWA and the anti-degradation policies set forth therein for agencies to ignore their duties to protect beneficial uses by failing to set standards for flow alteration.

We encourage EPA and DEQ to work together to reach a consensus and develop standards for flow alteration as the CWA requires. Standards for flow alteration are as important as TMDLs for other point and non-point sources of pollution. GYC looks forward to the final draft for Palisades Subbasin Assessment and Total Maximum Daily Load Allocations. Please keep us up to date on this project."

IDEQ has no legislative authority to recommend or mandate flow-related management. The Idaho Department of Water Resources exclusively manages water quantity. Flow alteration policies are stated in the WATER QUALITY STANDARDS AND WASTEWATER TREATMENT REQUIREMENTS (IDAPA 58.01.02), which were approved by the Idaho legislature:

050. ADMINISTRATIVE POLICY.
01. Apportionment of Water. *The adoption of water quality standards and the enforcement of such standards is not intended to conflict with the apportionment of water to the state through any of the interstate compacts or court decrees, or to interfere with the rights of Idaho appropriators, either now or in the future, in the utilization of the water appropriations which have been granted to them under the statutory procedure, or to interfere with water quality criteria established by mutual agreement of the participants in interstate water pollution control enforcement procedures.*

Comments received from Idaho Department of Fish and Game with responses in italics:

The IDFG comments were incorporated into the text.

Comments received from United States Environmental Protection Agency Region 10 with responses in italics:

1. <u>Waters proposed for delisting</u> – Page 44-46. The subbasin assessment proposes to remove Little Elk Creek, North Fork Indian Creek, Elk Creek, and Sheep Creek from the 303(d) list. These waters should remain listed for the following reasons:

- Elk Creek-The subbasin assessment indicates that the waterbody has a BURP site with an MBI score of 1.6. Based on State of Idaho's waterbody assessment guidance process, Elk Creek is considered not full support thus requiring a TMDL. The subbasin assessment should provide a full explanation as to why the waterbody should be delisted. Based on the current subbasin assessment, Elk Creek was proposed for delisting before identifying the unknown pollutant. The subbasin assessment also failed to identify potential sources (e.g. recreational activities) that may be contributing to the low MBI score.

The headwater site that resulted in a macroinvertebrate index score of 1.6 was sampled June 4 in high flow conditions. The bankfull, high-energy flow may have affected the macroinvertebrate sample. The biotic integrity report in Appendix B indicates that fine sediment associated with the high flow may have been impacting this site at the time of sampling, and that the sample size is very low. The other two macroinvertebrate index scores, taken at more typical sites, were very high—4.7 and 5.2, indicating that water quality is not impaired.

There is no evidence of streambank degradation in any of the Elk Creek drainage. The road through the Elk Creek watershed is high above the riparian zone. The upper watershed has had sheep grazing allotments since at least 1922, but this is in the upland and has not impacted the streambanks.

The 1996 IDEQ fish data includes at least three age classes of Yellowstone cutthroat trout including juveniles (see Table 7), so salmonid spawning is fully supported.

- Sheep Creek-The subbasin assessment indicates that the waterbody has a BURP site with an MBI score of 3.12. Based on State of Idaho's waterbody assessment guidance process, the impairment to Sheep Creek would need verification. The subbasin assessment should provide a full explanation as to why the waterbody should be delisted. Based on the current subbasin assessment, Sheep Creek was proposed for delisting before identifying the unknown pollutant. The proposal to delist Sheep Creek ignores the current impacts of grazing activities in Sheep Creek and its potential impact on the macroinvertebrate community. The assessment indicates that grazing has contributed to the mostly fine sediment substrate potentially contributing to the low MBI score.

Sheep Creek is a very small stream, approximately four to eight inches wide. On May 31, 1996 during a reconnaissance survey, the upper site at 5750 feet in elevation was measured at 0.9 cubic feet per second (cfs) streamflow and the lower site at 5720 feet was measured at 0.2 cfs. Such low flow during May when snowmelt runoff conditions should be occurring suggests that the stream is intermittent. Full biological communities are not attainable at this flow. Intermittent waters require an optimum flow greater than one cfs to support aquatic life uses, and Sheep Creek is apparently not attaining sufficient flow.

Idaho Water Quality Standards discuss application of standards to intermittent waters in IDAPA 58.01.02.070.07, which states,

> ***08. Application of Standards to Intermittent And Ephemeral Waters.***
> *Water quality standards apply to intermittent waters during optimum flow periods sufficient to support the uses for which the water body is designated. For recreation and water supply uses, optimum flow is equal to or greater than five (5) cubic feet per second (cfs). For aquatic life uses, optimum flow is equal to or greater than one (1) cfs.*

Intermittent water is defined as "[a] stream, reach, or waterbody which has a period of zero (0) flow for at least one (1) week during most years. Where flow records are available, a stream with a hydrologically-based flow of less than one-tenth (0.1) cfs is considered intermittent. Streams with natural perennial pools containing significant aquatic life uses are not intermittent" IDAPA 58.01.02.003.51.

Salmonid spawning is not supported due to flow alteration, lack of fish passage and lack of visible habitat. The flow alteration is a 55-gallon drum and pipes that have been installed in the streambed. Fish passage in Sheep Creek is precluded by this structure, lowering the water level in Palisades Reservoir and by Highway 26. Although human impacts are observed in the riparian area, Sheep Creek is affected by flow alteration and salmonid spawning is not a use. The beneficial use for salmonid spawning should be removed as an indication of water quality for this stream.

Sheep Creek will be removed from the 303(d) list because of its intermittent nature and extremely low flow. Water quality standards do not apply in this instance.

The public notice for the Palisades Subbasin TMDL did not inform the public that the TMDL package also included a proposal to delist Little Elk Creek, North Fork Indian Creek, Elk Creek, and Sheep Creek for the 303(d) list. One suggestion would be to public notice these waters separate from the TMDL.

The public notice stated "[p]ublic comment is also requested on the proposed removal of Elk, Little Elk, North Fork Indian and Sheep Creeks within the Palisades Watershed. The Department has assessed these waters and found the 1998 listings unwarranted at this time. No comments were received on the decision to remove these water bodies from the 303(d) list.

2. TMDL Allocations

- The TMDL should include a short section entitled Wasteload Allocation. In this section, include a short sentence that states, “Within the Palisades Subbasin, no point sources exist, therefore no wasteload allocation was developed”.

This fact has been added to pertinent sections of the TMDL.

- Sediment Load Allocations (for both Antelope and Bear Creek) – The TMDL identified sediment load reductions necessary to attain the 80% stable streambanks target. The TMDL failed to allocate the prescribed sediment reductions to the source(s) of pollution.

The sediment reduction will be allocated to areas where streambank stability is less than 80%. The determination of land management changes, if any, in areas with streambank stability less than 80% will be made by the US Forest Service as the designated land management agency. On private lands, East Side Soil and Water Conservation District and the Idaho Soil Conservation Commission will make with these determinations.

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APPENDIX A

Appendix A - IDEQ BURP sites Palisades subbasin.

Stream Name (Site ID No.)	Elevation (feet)	Stream Order	Rosgen Type	HI	MBI	% Fines	W/D Ratio	% Stable		% Cover	
								LB	RB	LB	RB
Antelope Creek (1994SIDFA013)	6360			85	3.79	38	20.5	55	55	65	55
Antelope Creek (1995SIDFA005)	5640		F	66	0.75	70	4.3	10	5	85	95
Bear Creek (1996SIDFY016)	7080	1									
Bear Creek (1996SIDFY015)	6820	2	F	81	2.21	64	8.5	7	34	59	59
Bear Creek (1996SIDFY031)	5680	4	B	92	5.13	19	32.3	59	70	62	55
Big Elk Creek (1996SIDFZ124)	5760	4	A	92	4.81	19	16.4	100	100	84	59
Booth Canyon Creek (1996SIDFZ026)	5640	1	A	94	2.67	85	2.1	78	79	95	100
Camp Creek (1996SIDFY030)	6120	1	B	81	1.97	61	12.5	20	30	90	97
Deer Creek (1996SIDFY007)	4880	1	A	97	4.66	61	5.8	91	88	85	91
Elk Creek (1996SIDFY011)	6680	1	A	103	1.43	54	8.5	88	78	82	88
Elk Creek (1996SIDFY012)	6120	2	B	97	4.45	56	16.2	76	69	85	97
Elk Creek (1996SIDFY013)	5800	3	B	91	5.05	34	14.4	61	89	83	97
Elk Creek West Fork (1996SIDFY025)	6120	2	A	103	4.30	52	9.2	78	75	93	100
Fall Creek (1996SIDFY014)	7120	1	A	92	1.89	60	18.9	79	73	88	90
Fall Creek (1996SIDFY017)	5720	4	C	73	2.85	53	9.7	16	14	78	65
Fall Creek (1996SIDFY032)	5440	4	C	85	5.10	36	10.9	44	28	68	77
Fall Creek South Fork (1996SIDFY019)	6420	2	B	92	3.51	61	13.4	83	91	98	98
Fall Creek South Fork (1996SIDFY018)	5560	3	C	87	4.32	47	11.2	79	85	93	96
Gibson Creek (1996SIDFY020)	6180	1	A	105	4.09	73	3.2	80	82	97	98
Gibson Creek (1996SIDFY024)	5920	2	A	84	4.02	91	2.2	72	82	91	96
Granite Creek (1996SIDFZ010)	5660	2	B	73	2.65	73	4.8	0	0	100	100
Hawley Gulch Creek (1997SIDFM010)	6140	1	G	106	4.67	76	5.3	89	77	93	81
Indian Creek (1998SIDFC007)	5750	3	B	77		30	65.4	34	100	34	100
Indian Creek (1996SIDFY010)	6400	1	B	103	4.90	61	15.6	94	90	90	97
Indian Creek (1996SIDFY008)	5460	2	B	91	3.92	55	10.5	86	90	97	93
Indian Creek North Fork (1996SIDFZ007)	5880	1	B	110	2.35	46	8.1	96	100	99	95
Indian Creek South Fork (1996SIDFZ006)	5880	1	B	91	1.08	39	15.7	100	84	92	84
June Creek (1996SIDFY022)	6140	1									
Little Elk Creek (1996SIDFZ009)	6070	1	A	75	1.54	61	23.1	75	92	25	0

Appendix A - IDEQ BURP sites Palisades subbasin, continued

Stream Name (Site ID No.)	Elevation (feet)	Stream Order	Rosgen Type	HI	MBI	% Fines	W/D Ratio	% Stable		% Cover	
								LB	RB	LB	RB
Little Elk Creek (1996SIDFZ004)	5685	2	A	105	2.60	75	5.8	100	100	98	96
Mike Spencer Canyon Creek (1996SIDFZ019)	6400	1	A	106	4.73	56	6	27	35	91	91
Mike Spencer Canyon Creek (1996SIDFY029)	6270	2	A	86	3.00	63	7.4	72	74	87	84
Monument Creek (1996SIDFY021)	6160	1	B	58	3.36	100	7.5	43	44	99	99
Palisades Creek (1996SIDFZ125)	5550	4	A	91	4.95	20	14.7	100	100	91	93
Pine Creek (1996SIDFZ021)	6400	1	C	106	4.51	71	6.4	96	100	92	94
Pine Creek (1996SIDFY026)	6360	2	B	73	3.86	63	22.7	69	62	71	71
Pine Creek (1996SIDFZ020)	5995	3	B	98	4.63	48	16.2	100	100	71	73
Pine Creek North Fork (1996SIDFZ122)	6020	3	B	76	4.49	31	22.6	100	100	6	0
Pine Creek West Fork (1996SIDFY028)	6000	2	B	74	5.72	41	18.9	89	77	91	76
Rainey Creek (1996SIDFZ123)	5510	4	B	91	4.96	47	11.3	100	100	86	38
Rainey Creek (1998SIDFC008)	5270	3	F	67		95	28.8	95	95	100	100
Rainey Creek North Fork (1996SIDFZ022)	6520	1	C	82	4.88	56	16.2	5	7	100	93
Russell Creek (1996SIDFY005)	5720	1	A	87	0.79	93	5	91	91	99	93
Sheep Creek (1996SIDFZ008)	5900	1	A	63	3.62	96	8.3	0	0	93	98
Sheep Creek (1996SIDFZ005)	5750	2	B	79	3.12	98	2.7	100	100	100	100
Squaw Creek (1996SIDFY009)	4840	2	A	75	2.63	99	2.3	99	83	100	84
Table Rock Canyon Creek (1996SIDFZ036)	5730	1	B	70	4.76	52	16.7	100	17	12	8
Tag Alder Creek (1996SIDFY004)	5800	1	A	87	1.83	81	8.1	98	97	98	91
Tie Canyon Creek (1996SIDFY027)	6300	2	B	102	5.14	65	9.1	56	69	82	86
Trail Creek (1996SIDFY023)	6160	2									
Yeaman Creek (1996SIDFY006)	4880	1	B	102	4.37	86	6	100	96	100	98
Average	5954	1.8		86	3.61	59	12.5	69	70	81	80
Maximum	7120	4		110	5.72	100	65.4	100	100	100	100
Minimum	4840	1		58	0.75	19	2.1	0	0	6	0

APPENDIX B

Palisades (HUC 17040104)
Bonneville, Madison, and Teton Counties, Idaho

Subbasin Assessment

Biotic Integrity (Macroinvertebrates)

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ABSTRACT

The macroinvertebrates of several streams in the Palisades area, Idaho, were sampled as part of the beneficial use reconnaissance project by the Idaho Department of Environmental Quality during early summer 1996. Ten stream segments were listed as water quality limited for HUC 17040104 and seven of those were listed as “pollutant unknown”. The objective of this study is to help determine the pollutant(s) responsible for the seven streams listed as water quality limited and pollutant unknown. Analysis of the macroinvertebrate data indicate that all seven streams (Bear Creek, Camp Creek, Elk Creek, Fall Creek, Little Elk Creek, North Fork Indian Creek and Sheep Creek) are impacted by fine sediment. Surface fine sediment data were also examined to assist in pollutant identification. In addition, the lower site on Little Elk Creek appears to be impacted by temperature. I recommend temperature monitoring for Little Elk Creek. I recommend additional macroinvertebrate monitoring for Elk Creek and Little Elk Creek because of low macroinvertebrate numbers found in the 1996 survey. I recommend additional macroinvertebrate sampling for North Fork Indian Creek and Sheep Creek to verify the sediment impacts on those streams. I recommend that the additional macroinvertebrate sampling be done within the Idaho Department of Environmental Quality collection time of July 1 through October 15.

INTRODUCTION

Macroinvertebrates of several 303(d) listed streams (Idaho Division of Environmental Quality 1999) in the Palisades area were sampled as part of the beneficial use reconnaissance project (BURP) by the IDEQ Idaho Falls Regional Office during 1996. The State Office of the IDEQ is using these data, in part, to prepare a subbasin assessment of the Palisades area.

Ten stream segments in HUC 17040104 were listed on the 1998 303(d) list (IDEQ 1999). Seven of these listed stream segments were reported as “pollutant unknown”. This report provides findings from an analysis of macroinvertebrate data on 14 sample sites on the seven streams in an attempt to identify the pollutant(s) responsible for the low macroinvertebrate biotic index scores and the subsequent 303(d) listing. Surface fines (percent fine sediment) taken at the sample sites is also used to help define limiting factors.

MATERIALS AND METHODS

Study Area

The study area is in USGS cataloging unit (HUC) 17040104 in the Palisades area, Bonneville, Madison, and Teton Counties, Idaho. The majority of the area lies within the Caribou and Targhee National Forests. Some private land

and lands administered by the Bureau of Land Management are found to the west of the National Forests. Seven stream sites are included in this report for macroinvertebrates for this project (Table B-1). The beneficial use reconnaissance project site identification number is included for reference.

Field Methods

Macroinvertebrate sample methods follow Clark and Maret (1993) and Idaho Division of Environmental Quality beneficial use reconnaissance project (IDEQ1996a). Three Hess samples were taken and combined for each of three separate riffles. Macroinvertebrates were processed by EcoAnalysts, Inc. of Moscow, Idaho. Voucher specimens of the macroinvertebrates have been deposited in the Orma J. Smith Museum of Natural History, Albertson College of Idaho, Caldwell. Fine sediment values were determined by using a modified Wolman pebble count at each of the three riffles sampled for macroinvertebrates.

Methods of Analysis

The macroinvertebrate sample metrics were interpreted consistent with current literature. Clark (1997) provides a draft list of cold water macroinvertebrate indicators for Idaho. Hafele and Hinton (1996), Oregon Watershed Enhancement Board (1999), Relyea (1999), PEERS (1998), and Wisseman (1996) were especially helpful in determining the tolerance of the invertebrates collected to fine sediment. Tables 3, 4, and 5 list the metrics examined for this study.

The macroinvertebrate biotic index (MBI) scores were calculated using IDEQ (1996b) water body assessment guidance process. The MBI uses the seven metrics discussed in detail above (taxa richness, EPT index, percent Ephemeroptera, Plecoptera, and Trichoptera (EPT), percent scrapers, percent dominant taxa, the Hilsenhoff Biotic Index, and Shannon=s H= diversity index). In summary, this process was developed by IDEQ as a non-arbitrary, objective water body assessment tool. An MBI score of 2.5 or less renders an impaired call for aquatic life (cold water biota in most cases). An MBI score of 3.5 or greater is determined to be not impaired. If a score falls between 2.5 and 3.5 the site was considered too close to determine and given a rating of “needs verification” (IDEQ 1999).

Cold water indicators (Table 3) are compared with a draft list prepared for Idaho (Clark 1997) and for the Pacific Northwest (Hafele and Hinton 1996). Essig (1998) is a good reference for examination of the dilemma associated with temperature criteria in Idaho. Clark (1999) provides information useful for determining the identification and distribution of aquatic macroinvertebrates in Idaho.

The macroinvertebrate metrics currently used by IDEQ to calculate the macroinvertebrate biotic index include: percent Ephemeroptera, Plecoptera, and Trichoptera (EPT), modified Hilsenhoff Biotic Index (HBI), percent scrapers, percent dominance, EPT index, taxa richness, and Shannon=s H= diversity index. In addition to those metrics, I have also examined six additional (total abundance, percent Ephemeroptera, percent Plecoptera, percent Trichoptera, number of Ephemeroptera taxa, and number of Plecoptera taxa) that provide additional information concerning the sites studied. The metrics examined can be separated into four categories: richness, composition, tolerance, and trophic/habitat.

Richness (or community structure)

Taxa richness reflects the health of the assemblage through a measure of the variety of taxa (total number of distinct genera or species) present. Taxa richness can be equated to biodiversity. Taxa richness generally increases with increasing water quality, habitat diversity, or habitat suitability. Barbour and others (1992) and Karr and Chu (1999) report that taxa richness is a reliable indicator of human influence in the Pacific Northwest and will generally decrease with an increase in such influence. The EPT index is a metric that summarizes the taxa richness of these three orders of insects that are generally considered to be sensitive to pollution (including temperature and fine sediment). Barbour and others (1992) reports that EPT Index is a reliable indicator of human influence in the Pacific Northwest and will generally decrease with an increase in such influence. It follows then that the number of Ephemeroptera taxa and the number of Plecoptera taxa will likewise be good indicators of temperature and fine sediment pollution. It is sometimes helpful to look at these taxa separately although they are considered in the two previously mentioned metrics. Karr and Chu (1999) show that these three metrics are reliable indicators of human influence across the Pacific Northwest, including central Idaho. Another way to measure diversity is with Shannon's H' diversity index. This metric is based on the observation that relatively undisturbed environments support communities having great taxa richness with no individual species present in overwhelming abundance. It has been one of the most popular diversity indices used for water quality assessment.

Composition

Percent EPT increases as water quality increases, since these groups generally contain taxa that are considered more sensitive to temperature and fine sediment pollution. Karr and Chu (1999) show that these taxa decreased with increased human influence in the Pacific Northwest. They show the same relationship between intolerant taxa (which include EPT). It likewise follows, that each of the EPT groups examined separately (percent Ephemeroptera, percent Plecoptera, and percent Trichoptera) will also show the same trend in relation to temperature and fine sediment pollution. It may be useful to examine these metrics separately at times. Total Abundance of macroinvertebrate organisms in a sample can also serve as an indicator of stream health. Generally greater total abundance will indicate a stream of decreased impact and increased water quality. There comes a point (this is dependent on the particular stream, impacts, and taxa present) where larger Total Abundance indicates a decrease in water quality. This condition is evident when pollution (which includes temperature and fine sediment) has reduced or eliminated the sensitive species and the remaining tolerant species thrive with the resulting reduced competition.

Tolerance

The Hilsenhoff Biotic Index (HBI) was originally a measure of organic pollution. It has been modified several times. Each macroinvertebrate taxon is assigned a tolerance value relating to the response to organic and toxic pollutants. A value of 0-10 may be assigned to each taxon, with zero being the least tolerant to pollution (inverse relationship). A score of 11 indicates the tolerance value is unknown. These have also been shown to be useful for evaluating both point and nonpoint source affects. The US Environmental Protection Agency (1997) and Barbour and others (1999) indicate that the HBI is useful in determining the impacts of nonpoint source pollution. Percent dominance represents the percent contribution of the numerically dominant taxon to the total number of individuals in the community. It provides an indication of community balance at the lowest positive taxonomic level (usually genus or species). A community dominated by relatively few species would suggest environmental stress. Percent dominance will increase with the impacts of human influence on streams in the Pacific Northwest (Karr and Chu 1999).

Trophic/Habitat

Percent scrapers uses the functional feeding group approach to assessment. The relative abundance of scrapers provides an indication of the riffle community food base (periphyton or primary production composition). Scrapers increase with increased abundance of diatoms and decrease as filamentous algae and aquatic mosses increase. Scrapers decrease in relative abundance following increases in fine particle sedimentation in coarse particle substrate stream beds. Percent scrapers has been shown to be sensitive to human influence in Central Idaho (Karr and Chu 1999).

RESULTS AND DISCUSSION

Following is a list of the seven sampled streams and 14 sample sites and a summary of their macroinvertebrate data as they relate to sediment impacts and water temperature tolerance.

Bear Creek

Bear Creek consisted of two sites (1996SIDFY015, a second order stream sampled on June 5; and 1996SIDFY031, a third order stream sampled on June 9). The upper site had the lowest MBI (2.2) of the two indicating that the site is not full support for cold water biota while the lower site had an MBI of 5.32 shows full support for cold water biota (Table 2).

The upper site on Bear Creek appears to be impacted by fine sediment (very low composition of scrapers, 6.8%, Table 4, and a high percentage of fine sediment, 64%, Table 2) at the collection site.

The upper site had two cold water indicators (including *Prosimulium*, n=368), giving them 75% of the total taxa present (Table 3). The lower site had a single cold water species, *Drunella doddsi* (Clark 1997 and PEERS 1998). Therefore, it does not appear that increased temperatures are a problem on Bear Creek.

Camp Creek

Camp Creek was represented by a single sample site (1996SIDFY030, a first order stream sampled on June 19). Camp Creek had a low MBI score of 1.89 indicating that the site was impaired for cold water biota beneficial use (Table 2). The Camp Creek site had a relatively high sediment value (61% fines, Table 2).

Camp Creek had a single cold water taxon, *Prosimulium*, which was in abundance (469 individuals or 73% of the total macroinvertebrates at this site)(Table 3). In addition, the macroinvertebrate assemblage at this site had an very low scraper composition (0.31%)(Table 4). These preliminary data indicate that the limiting factor may be fine sediment rather than temperature.

Elk Creek

Elk Creek was represented by three sites (1996SIDFY011, a first order site; 1996SIDFY012, a second order site; and 1996SIDFY013, a third order site, all three sampled on June 4). The MBI scores for these sites are 1.6, 4.7, and 5.2, respectively (Table 2). The upper two sites on Elk Creek had fine sediment values exceeding 50% (Table 2).

All three sites have cold water macroinvertebrate indicators (Table 3) which indicates that temperature was not a problem. However, the uppermost site has the fewest cold water macroinvertebrate indicators (one cold water taxon, *Prosimulium*, for a total of 3.6%). The site had a low total abundance (28) and taxa richness (6)(Table 4) which may be a result of the headwater nature of the habitat. The macroinvertebrate assemblage at this site contained no scrapers (Table 4). The data suggest that fine sediment may be the primary pollutant of concern in Elk Creek.

The macroinvertebrate sample size for the three sites is very low (abundance values of 28 for the upper site, 55 for the middle site, and 52 for the lower site (Table 4). These samples may be too low to give meaningful results. I recommend additional sampling for Elk Creek in an attempt to increase the macroinvertebrate sample size.

Fall Creek

Fall Creek was represented by three sample sites (1996SIDFY014, a first order site sampled on June 5; 1996SIDFY017, a second order site sampled on June 6; and 1996SIDFY032, a third order stream site sampled on June 20). The sites had MBI scores of 2.1, 3.4, and 5.3 respectively (Table 2). These MBI results are very similar to the MBI scores of Elk Creek. The upper two sites on Fall Creek had surface fines exceeding 50% (Table 2).

All three sites have cold water macroinvertebrate indicators (Table 3) which indicates that temperature was not a problem. The upper site appears to be impacted by fine sediment since no Ephemeroptera or Plecoptera are present (Table 5). These groups are found at the lower two sites.

Little Elk Creek

Little Elk Creek was represented by two sample sites (1996SIDFZ004, a first order site located above site 009 sampled on June 3; and 1996SIDFZ009, a second order site located near the mouth of the creek sampled on May 30). The lower site appears to be of lower water quality as compared to the upper site (MBI 1.83 and MBI 3.6 respectively, Table 2).

While the upper site (004) had an MBI indicating full support for cold water biota, the macroinvertebrates consist mostly of pollution tolerant *Baetis* and a few other mostly tolerant taxa. Little Elk Creek had high concentrations of fine sediment at the sample sites (61% and 75%, Table 2). The upper site had the highest percentage of scrapers (85%, Table 4) compared with the other stream sites in this survey which is usually associated with areas not impacted with fine sediment. There is an inconsistency of data here but it may relate to the low sample size (Table 4).

The lower site (009) had no macroinvertebrate cold water indicators present (Table 3) and appeared to be impacted by increased water temperature. This site also appeared to be impacted by fine sediment as only sediment tolerant macroinvertebrates (Chironomidae, Simuliidae, and Oligochaeta) were present and in very low numbers, no Plecoptera or Trichoptera were present in the samples. The macroinvertebrate assemblage at the lower site had no scrapers (Table 4), indicating potential impact of fine sediment.

The macroinvertebrate sample size for the two sites are very low (total abundance values of 60 for the upper site and four for the lower site, Table 4). These samples may be too low to give meaningful results. I recommend additional sampling for Little Elk Creek in an attempt to increase the macroinvertebrate sample size.

North Fork Indian Creek

The North Fork Indian Creek was represented by a single sample (1996SIDFZ007) collected on May 31 at a first order site. The MBI indicated that the site fell within the Aneeds verification@ range. The site had three cold water macroinvertebrate taxa for a total of 26.8% of the total present (Table 3) which should indicate that high stream temperatures are not a problem. The site certainly had some intolerant taxa (for example the mayfly, *Drunella*). It also had relatively high numbers of tolerant taxa (for example Diptera, Chironomidae and the mayfly, *Baetis*) indicating that there could be some fine sediment impacts present.

I suggest that additional sampling and study of the North Fork Indian Creek be done to determine if fine sediment is a significant pollutant in this stream.

Sheep Creek

Sheep Creek was represented by two sample sites (1996SIDFZ008 a first order stream; and 1996SIDFZ005 a second order stream, both sampled on May 31). The MBI scores for both sites on Sheep Creek indicated full support for cold water biota (4.38 and 4, respectively)(Table 2). Both sites contained cold water macroinvertebrate indicators (one for 14.4% of the total and 2 for 0.85% of the total respectively)(Table 3). The macroinvertebrates at the two sites on Sheep Creek appeared to be impacted to some extent by fine sediment. While there are good numbers of sediment intolerant taxa present (for example *Drunella*) these are outnumbered by sediment tolerant Diptera, Coleoptera, Ephemeroptera (*Baetis*), Ostracoda, Oligochaeta, and Mollusca. Fine sediment values for the two sample sites (96% and 98% respectively, Table 2) were the highest for the streams discussed in this report.

Because of the inconsistency of high MBI scores but mostly tolerant organisms present, I suggest that additional sampling and study of Sheep Creek be done to determine if sediment is a significant pollutant in this stream.

CONCLUSIONS AND RECOMMENDATIONS

1. According to the macroinvertebrate data collected, Bear Creek appears to be <u>impacted by fine sediment</u> and not temperature.

2. The macroinvertebrate data collected on Camp Creek and the percent surface fines found at the collection site indicate that the <u>limiting factor is fine sediment</u> and not temperature.

3. Increased temperature does not appear to be a problem on Elk Creek, but according to the macroinvertebrate samples taken, <u>fine sediment may be the limiting factor</u>.

4. Fall Creek seems to be <u>impacted by fine sediment</u> and not by increases in temperature,

5. The macroinvertebrate data collected indicate that Little Elk Creek seems to be <u>impacted by fine sediment</u>. The lower site on Little Elk Creek may also be <u>impacted by increased temperature</u>.

6. The North Fork Indian Creek appears to be <u>impacted by fine sediment</u>, after examination of the macroinvertebrate assemblages collected there.

7. Examination of the macroinvertebrate samples collected, as well as the surface fine sediment values, indicate that <u>sediment is the pollutant of concern</u> on Sheep Creek.

8. I recommend temperature monitoring for Little Elk Creek, based on the macroinvertebrate data examined.

9. I recommend additional macroinvertebrate sampling for Elk Creek and for Little Elk Creek because the total abundance values were so low in the 1996 samples. I question if the sample size was adequate to properly describe the macroinvertebrate metrics used. Sampling should be done within the IDEQ collection time (July 1-October 15).

10. I recommend additional macroinvertebrate sampling for the North Fork Indian Creek and Sheep Creek in order to better identify the potential pollutants to these streams. Sampling should be done within the IDEQ collection time (July 1-October 15).

Acknowledgments

EcoAnalysts, Inc. (Gary Lester) provided the macroinvertebrate identifications of the 1996 samples presented here. The Idaho Falls IDEQ Regional Office BURP crew took the field samples. Thanks to Steve Robinson for coordinating the fieldwork. Don Zaroban, Mark Shumar, Darcy Sharp, and Sheryl Hill assisted with data summary.

Table B-1. 1999 Macroinvertebrate collections for Palisades, Idaho, 1996 (HUC 17040104). Streams that have more than one site have the upper most site listed first and continue down the list so that the last site listed is lowest in the watershed.

STREAM	SITE	SITE ID	303(d) Listed Pollutant
Bear Creek	0.8 mi below road crossing	1996SIDFY015	unknown
	5 m above Elk Creek	1996SIDFY031	
Camp Creek	30 m above crossing	1996SIDFY030	unknown
Elk Creek	10 m above 1st tributary	1996SIDFY011	unknown
	350 m above W. Fork	1996SIDFY012	
	0.2 mi above lowest trib.	1996SIDFY013	
Fall Creek	300 m below Basin trail	1996SIDFY014	unknown
	300 m above Monument Cr.	1996SIDFY017	
	0.5 mi above Currant Hollow	1996SIDFY032	
Little Elk Creek	0.9 mi above US Hwy. 26	1996SIDFZ004	unknown
	10 m above confluence	1996SIDFZ009	
NF Indian Creek	2 mi N US Hwy. 26	1996SIDFZ007	unknown
Sheep Creek	1.8 mi N US Hwy. 26	1996SIDFZ008	unknown
	1.2 mi N US Hwy. 26	1996SIDFZ005	

Table B-2. 1999 Macroinvertebrate biotic index scores and surface percent fine sediment for the Palisades area, Idaho, 1996 (HUC 17040104).

STREAM	SITE ID	MBI	%Fines
Bear Creek	1996SIDFY015	2.20	64
	1996SIDFY031	5.32	19
Camp Creek	1996SIDFY030	1.89	61
Elk Creek	1996SIDFY011	1.59	54
	1996SIDFY012	4.74	56
	1996SIDFY013	5.22	34
Fall Creek	1996SIDFY014	2.11	60
	1996SIDFY017	3.39	53
	1996SIDFY032	5.30	36
Little Elk Creek	1996SIDFZ004	3.60	61
	1996SIDFZ009	1.83	75
North Fork Indian Creek	1996SIDFZ007	2.53	46
Sheep Creek	1996SIDFZ005	4.00	96
	1996SIDFZ008	4.38	98

Table B-3. 1999 Macroinvertebrate cold water indicators for the Palisades area, Idaho, 1996 (HUC 17040104).

STREAM	SITE ID	# COLD WATER TAXA	% COLD WATER TAXA
Bear Creek	1996SIDFY015	2	75.25
	1996SIDFY031	0	0
Camp Creek	1996SIDFY030	1	72.83
Elk Creek	1996SIDFY011	1	3.57
	1996SIDFY012	5	36.36
	1996SIDFY013	3	25.0
Fall Creek	1996SIDFY014	2	8.52
	1996SIDFY017	1	1.65
	1996SIDFY032	3	6.56
Little Elk Creek	1996SIDFZ004	1	80.0
	1996SIDFZ009	0	0
North Fork Indian Creek	1996SIDFZ007	3	26.81
Sheep Creek	1996SIDFZ005	2	0.85
	1996SIDFZ008	1	14.39

Table B-4. Macroinvertebrate data (taxa richness, total abundance, HBI, H', percent scrapers) for the Palisades area, Idaho, 1996 (HUC 17040104).

Water Body/Site ID	Taxa Richness	Total Abundance	HBI	H'	Percent Scrapers
Bear Creek (Y015)	16	501	4.15	0.46	6.79
(Y031)	30	388	2.74	1.19	43.3
Camp Creek (Y030)	16	644	4.36	0.41	0.31
Elk Creek (Y011)	6	28	4.71	0.52	0.00
(Y012)	16	55	1.26	1.03	36.36
(Y013)	16	52	2.29	1.04	61.54
Fall Creek (Y014)	14	528	5.23	0.64	13.26
(Y017)	16	182	1.59	0.73	19.78
(Y032)	26	244	2.31	1.17	31.56
Little Elk Creek (Z004)	7	60	2.4	0.35	85.00
(Z009)	3	4	3.00	0.45	0.00
NF Indian Cr. (Z007)	9	138	4.36	0.61	18.84
Sheep Creek (Z005)	19	587	3.70	0.76	51.62
(Z008)	16	417	3.81	0.73	63.55

Table B-5. Macroinvertebrate metric data (percent EPT, sum EPT taxa, percent Ephemeroptera, percent Plecoptera, percent Trichoptera, number of Ephemeroptera taxa, number of Plecoptera taxa) for the Palisades area, Idaho, 1996 (HUC 17040104).

Water Body/Site ID	Percent EPT	SumEPTtaxa	%Ephem	%Plec	%Trich	#Plec Taxa
Bear Creek (Y015)	7.19	8	5.79	0.80	0.60	1
(Y031)	68.81	16	53.61	4.38	10.82	3
Camp Creek (Y030)	6.37	4	4.19	0.31	1.86	2
Elk Creek (Y011)	0.00	0	0.00	0.00	0.00	0
(Y012)						
	67.27	11	32.73	14.55	20.00	2
(Y013)						
	84.62	12	53.85	1.92	28.85	1
Fall Creek (Y014)						
	0.38	1	0.00	0.00	0.38	0
(Y017)						
	31.32	9	22.53	4.95	3.85	2
(Y032)						
	74.18	17	53.69	9.02	11.48	3
Little Elk Creek (Z004)						
(Z009)	85.00	3	85.00	0.00	0.00	0
NF Indian Cr. (Z007)	0.00	0	0.00	0.00	0.00	0
Sheep Creek (Z005)	27.54	4	21.74	0.00	5.80	0
(Z008)	55.54	8	54.17	0.34	1.02	1
	84.65	8	83.21	0.00	1.44	0

APPENDIX C

SEDIMENT TMDL METHODS AND RESULTS

Introduction

This appendix documents the analytical techniques and data used to develop the gross sediment budget and instream sediment measures used in calculating the load allocations for Antelope and Bear Creeks. The methods, data, and results for streambank erosion inventories and subsurface fine sediment data collection techniques are provided. These data are intended to

1. characterize the natural and existing condition of the stream channels and riparian zones;
2. estimate the desired level of erosion and sedimentation; and
3. provide baseline data to track the effectiveness of TMDL implementation.

The streambank erosion inventories and sediment data collection techniques can be repeated and ultimately provide an adaptive management or feedback mechanism.

Streambank Erosion Inventory

The streambank erosion inventory used to estimate background and existing streambank erosion followed methods outlined in the proceedings from the Natural Resource Conservation Service (NRCS) Channel Evaluation Workshop (1983). Using the direct volume method, Antelope and Bear Creeks listed in 1998 §303(d) were surveyed to determine the extent of chronic bank erosion and estimate the needed reductions.

The NRCS stream bank erosion inventory is a field method that estimates streambank/channel stability, length of active eroding banks, and bank geometry. The streambank/channel stability inventories were used to estimate the long-term lateral recession rate. The recession rate is determined from field evaluation of streambank characteristics that are assigned a categorical rating ranging from zero to three. The rating factors and rating scores are:

Bank Stability:

Do not appear to be eroding - 0
Erosion evident - 1
Erosion and cracking present - 2
Slumps and clumps sloughing off - 3

Bank Condition:

Some bare bank, few rills, no vegetative overhang - 0
Predominantly bare, some rills, moderate vegetative overhang - 1
Bare, rills, severe vegetative overhang, exposed roots - 2
Bare, rills and gullies, severe vegetative overhang, falling trees – 3

Vegetation / Cover On Banks:

Predominantly perennials or rock-covered - 0
Annuals / perennials mixed or about 40% bare - 1
Annuals or about 70% bare - 2
Predominantly bare - 3

Bank / Channel Shape:

V - shaped channel, sloped banks - 0
Steep V - shaped channel, near vertical banks - 1
Vertical banks, U - shaped channel - 2
U - shaped channel, undercut banks, meandering channel - 3

Channel Bottom:

Channel in bedrock / noneroding - 0
Soil bottom, gravels or cobbles, minor erosion - 1
Silt bottom, evidence of active downcutting - 2

Deposition:

No evidence of recent deposition - 1
Evidence of recent deposits, silt bars - 0

Cumulative Rating

Slight (0-4) Moderate (5-8) Severe (9+)

From the Cumulative Rating, the lateral recession rate is assigned.

0.01 - 0.05 feet per year	**Slight**
0.06 - 0.15 feet per year	**Moderate**
0.16 - 0.3 feet per year	**Severe**
0.5+ feet per year	**Very Severe**

Streambank stability can also be characterized through the following definitions. The corresponding streambank erosion condition ratings from Bank Stability or Bank Condition factors are included in italics.

Streambanks are considered stable if they do not show indications of any of the following features:

- **Breakdown** - obvious blocks of bank broken away and lying adjacent to the bank breakage. *Bank Stability Rating 3*
- **Slumping or false bank** - bank has obviously slipped down, cracks may or may not be obvious, but the slump feature is obvious. *Bank Stability Rating 2*
- **Fracture** - a crack is visibly obvious on the bank indicating that blocks of the bank are about to slump or move into the stream. *Bank Stability Rating 2*
- **Vertical and eroding** - the bank is mostly uncovered and the bank angle is steeper than 80 degrees from the horizontal. *Bank Stability Rating 1*

Streambanks are considered covered if they show any of the following features:

- Ground cover with perennial vegetation is greater than 50 percent. *Vegetation/Cover Rating 0*
- Roots of vegetation cover more than 50 percent of the bank (deeply rooted plants such as willows and sedges provide such root cover). *Vegetation/Cover Rating 1*
- At least 50 percent of the bank surfaces are protected by rocks of cobble size or larger. *Vegetation/Cover Rating 0*
- At least 50 percent of the bank surfaces are protected by logs of four-inch diameter or larger. *Vegetation/Cover Rating 1*

Streambank stability is estimated using a simplified modification of Platts and others (1983) as stated in *Monitoring Protocols to Evaluate Water Quality Effects of Grazing Management on Western Rangeland Streams* (Bauer and

Burton 1993). The modification allows for measuring streambank stability in a more objective fashion. The lengths of banks on both sides of the stream throughout the entire linear distance of the representative reach are measured and proportioned into four stability classes:

- **Mostly covered and stable (non-erosional)** - streambanks are over 50 percent covered as defined above. Streambanks are stable as defined above. Banks associated with gravel bars having perennial vegetation above the scourline are in this category. *Cumulative Rating 0 - 4 (slight erosion) with a corresponding lateral recession rate of 0.01 - 0.05 feet per year.*
- **Mostly covered and unstable (vulnerable)** - streambanks are over 50 percent covered as defined above. Streambanks are unstable as defined above. Such banks are typical of Afalse banks" observed in meadows where breakdown, slumping, and/or fracture show instability yet vegetative cover is abundant. *Cumulative Rating 5 - 8 (moderate erosion) with a corresponding lateral recession rate of 0.06 - 0.2 feet per year.*
- **Mostly uncovered and stable (vulnerable)** - streambanks are less than 50 percent covered as defined above. Streambanks are stable as defined above. Uncovered, stable banks are typical of streambanks trampled by concentrations of cattle. Such trampling flattens the bank so that slumping and breakdown do not occur even though vegetative cover is significantly reduced or eliminated. *Cumulative Rating 5 - 8 (moderate erosion) with a corresponding lateral recession rate of 0.06 - 0.2 feet per year.*
- **Mostly uncovered and unstable (erosional)** - streambanks are less than 50% Covered as defined above. They are also Unstable as defined above. These are bare eroding streambanks and include ALL banks mostly uncovered, which are at a steep angle to the water surface. *Cumulative Rating 9+ (severe erosion) with a corresponding lateral recession rate of over 0.5 feet per year.*

Streambanks were inventoried to quantify bank erosion rate and annual average erosion. These data were used to develop a quantitative sediment budget to develop the load allocation.

Site Selection

The first step in the bank erosion inventory is to identify problem areas. Streambank erosion tends to increase as a function of watershed area (NRCS 1983). Consequently, the lower stream segments of larger watersheds tend to be problem areas. These stream segments tend to be alluvial streams commonly classified as response reaches, Rosgen (1996) B and C channel types.
Because it is often unrealistic to survey every stream segment, representative reaches were used and bank erosion rates are extrapolated over a larger stream segment. The length of the reach to be sampled is a function of stream type variability where streams segments with highly variable channel types need a large sample, whereas segments with uniform gradient and consistent geometry need less. The IDEQ typically inventories between 10 and 30 percent of streambank. Often, the location of some stream inventory reaches is more dependent on land ownership than watershed characteristics. For example, private landowners are sometimes unwilling to allow access to stream segments within their property.

Stream reaches are subdivided into sites with similar channel and bank characteristics. Breaks between sites are made where channel type and/or dominate bank characteristics change substantially. In a stream with uniform channel geometry, there may be only one site per stream reach, whereas in an area with variable conditions there may be several sites. Subdivision of stream reaches is at the discretion of the field crew leader.

Field Methods

Streambank erosion or channel stability inventory field methods were originally developed by the US Forest Service (Pfankuch 1975). Later inventory methods of channel stability are outlined in Lohrey (1989) and NRCS (1983). As stated above, the NRCS (1983) document outlines field methods used in this inventory. However, slight modifications to the field methods are documented.

Field crews typically consist of two to four people who are trained as a group to ensure quality control or consistent data collection. Field crews survey selected stream reaches measuring bank length, slope height, bankfull width and depth, and bank content. In most cases, a global positioning system (GPS) is used to locate the upper and lower boundaries of inventoried stream reaches. Additionally, while surveying field crews photograph essential problem areas.

Bank Erosion Calculations

The direct volume method is used to calculate average annual erosion rates for a given stream segment based on bank recession rate determined in the survey (NRCS 1983). The erosion rate (tons/mile/year) is used to estimate the total bank erosion of the selected stream corridor. The direct volume method is summarized in the following equations:

$$E = [A_E * R_{LR} * \rho_B]/2000 \text{ (lbs/ton)}$$

where:
E = bank erosion over sampled stream reach (tons/yr/sample reach)
A_E = eroding area (ft^2)
R_{LR} = lateral recession rate (ft/yr)
ρ_B = bulk density of bank material (lbs/ft^3)

The bank erosion rate (E_R) is calculated by dividing the sampled bank erosion (E) by the total stream length sampled:

$$E_R = E/L_{BB}$$

where:
E_R = bank erosion rate (tons/mile/year)
E = bank erosion over sampled stream reach (tons/yr/sample reach)
L_{BB} = bank to bank stream length over sampled reach

Total bank erosion is expressed as an annual average. However, the frequency and magnitude of bank erosion events are greatly a function of soil moisture and stream discharge (Leopold and others 1964). Because channel erosion events typically result from above average flow events, the annual average bank erosion value is considered a long term average. For example, a 50-year flood event might cause five feet of bank erosion in one year and over a ten-year period this event accounts for the majority of bank erosion.

The *eroding area* (A_E) is the product of linear horizontal bank distance and average bank slope height. Bank length and slope heights are measured while walking along the stream channel. Pacing is used to measure horizontal distance, and bank slope heights are continually measured and averaged over a given reach or site. The horizontal length is the length of the right or left bank, not both. Typically, one bank along the stream channel is actively eroding, as in the bank on the outside of a meander.

Determining the *lateral recession rate* (R_{LR}) is one of the most critical factors in this methodology (NRCS 1983). To facilitate consistent data collection, the NRCS developed rating factors used to estimate lateral recession rate. Similar to methods developed by Pfankuch (1975), the NRCS method measures bank and channel stability, and then uses the ratings as surrogates for bank erosion rates. The IDEQ developed recession rates using the NRCS methods.

The *bulk density* (ρ_B) of soil is the weight of material divided by its volume, including the volume of its pore spaces. A table of typical soil bulk densities can be used, (NRCS 1983) or soil samples can be collected and soil bulk density measured in the laboratory. Copies of the streambank erosion inventory worksheets for Antelope Creek and Bear Creek are provided on pages C-9 and C-10 of this appendix.

Subsurface Fine Sediment Sampling

McNeil (McNeil and Ahnell 1964) sediment core samples were collected to describe size composition of bottom materials in salmonid spawning beds of Antelope and Bear Creeks. Research has shown that subsurface fine sediment composition is important to egg and fry survival (Hall 1986) and (Reiser and White 1988). These data are presented after the narrative section of this appendix.

Site Selection

Sample sites selected displayed characteristics of gravel size, depth and velocity required by salmonids to spawn and were determined to be adequate spawning substrate by an experienced fisheries biologist. Samples were collected during periods of low discharge, as described in McNeil and Ahnell (1964) to minimize loss of silt in suspension within the core sampling tube. Sample sites were generally in the lower reach of streams where spawning habitat was determined to exist.

Field Methods

A 12-inch diameter stainless steel open cylinder was worked at least 4 inches into spawning substrate without allowing flowing water to top the core sampling tube. Samples of bottom materials were removed by hand, using a stainless steel mixing bowl, to a depth of at least 4 inches and placed into buckets. After solids were removed from the core sampling tube and placed into buckets, the remaining suspended material was discarded. It is felt that this fine material would be removed through the physical action of a fish excavating a redd and would not be a significant factor with regard to egg to fry survival. Additionally, rinsing of sieves to process the sample results in some loss of the fraction below the smallest (0.0021 inches) mesh size.

Samples were placed wet into a stack of sieves and were separated into 10 size classes by washing and shaking them through nine standard Tyler sieves having the following square mesh openings (in inches): 2.5, 1.0, 0.5, 0.25, 0.187, 0.937, 0.331, 0.0083 and 0.0021. Silt passing the finest screen was discarded.

The volume of solids retained by each sieve was measured after the excess water had drained. The contents of each of the sieves were placed in a bucket filled with water to the level of a spigot for measurement by displacement. The water displaced by solids was collected in a plastic bucket, transferred to a graduated cylinder, and measured directly. Variation in sample volumes was caused by variation in porosity and core depth. All sample fractions were expressed as a percentage of the total sample with and without the 2.5-inch fraction. The 2.5-inch particles are eliminated since they are generally too large for resident salmonids to move while building a spawning redd.

Three sediment core samples were collected at each sample site and grouped together by fractions 0.25 inches and greater and from 0.187 inches to 0.0021 inches. The results for a particular site are the percentage of 0.187 inches to 0.0021 inches as a portion of the total sample. Standard deviation is calculated for estimates including and excluding particles 2.5 inches and above. Copies of the McNeil sediment core sampling forms for Antelope Creek and Bear Creek are provided on pages C-11 through C-13.

Stream Bank Erosion Inventory Worksheet

Stream Antelope Creek
Section Lower Boundary of Upper Reach
Field Crew Tom Herron, Don Zaroban and Darcy Sharp
Data reduced by Darcy Sharp

Land Use Forest Service

Stream Segment Location

		Degrees	Minutes	Elevation
GPS: Upstream	N	43	27.794	6200
	W	111	33.844	
Downstream	N	43	27.954	6080
	W	111	33.903	

Stream Bank Erosion Calculations

AVE. Bank Height:	3.1	feet	**Inv. bank to bank length (L_{BB})**	3672	feet
bank to bank Eroding Seg. Length	701	feet	(Inventoried stream length X 2)		
Percent eroding bank	0.19				
Bank erosion over sampled reach (E)	29	tons/year/sample reach			
Erosion Rate (E_R)	84	tons/mile/year			
Feet of Similar Stream Type	3324	feet			
Eroding bank extrapolation	1970.13	feet			
Total stream bank erosion	**82**	tons/year			

Stream Bank Erosion Reduction Calculations

Bank erosion over sampled reach (E)	5	tons/year/sample reach
Erosion Rate (E_R)	15	tons/mile/year
Feet of Similar Stream Types	3324.00	feet
Eroding bank extrapolation	2064.00	feet
Total stream bank erosion	**14.3**	tons/year

Comments

Flow a contributing factor?: Yes. Due to downcutting, there is limited access to the floodplain to dissipate energy

Other contributing factors?: Bank chiseling is obvious with little residual vegetation after grazing. Willows are present, with reduced density.
Other Notes: Some areas have cut down to bedrock.

Stream Bank Erosion Inventory Worksheet

Stream Bear Creek
Section Approximately four miles from trailhead; extrapolated to confluence with Warm Springs Creek
Field Crew Tom Herron; Don Zaroban **Data reduced by** Darcy Sharp

Land Use Recreation; historic grazing

Stream Segment Location

		Degrees	Minutes	Elevation
GPS: Upstream	N	43	17.229	
	W	111	17.053	
Downstream	N	43	17.086	
	W	111	16.570	

Stream Bank Erosion Calculations

AVE. Bank Height:	4.9	feet	**Inv. bank to bank length (L_{BB})**	2188	feet
bank to bank Eroding Seg. Length	692	feet	(Inventoried stream length X 2)		
Percent eroding bank	0.32				
Bank erosion over sampled reach (E)	58	tons/year/sample reach			
Erosion Rate (E_R)	280	tons/mile/year			
Feet of Similar Stream Type	13780	feet			
Eroding bank extrapolation	9408.42	feet			
Total stream bank erosion	**790**	tons/year			

Stream Bank Erosion Reduction Calculations

Bank erosion over sampled reach (E)	5	tons/year/sample reach
Erosion Rate (E_R)	23	tons/mile/year
Feet of Similar Stream Types	13780.00	feet
Eroding bank extrapolation	5949.60	feet
Total stream bank erosion	**65.7**	tons/year